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08 Secure Your Wi-fi

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58 Strange Crowdfunding Ideas

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HOW **SAFE** IS YOUR **WI-FI?**

David Crookes looks at how you can make your home's wireless network more secure

When a letter popped through the door of a friend warning him to stop downloading copyrighted material, he was understandably concerned. As someone who would recoil in horror if anyone thought he was up to something dodgy, he racked his brain trying to work out how it could have happened. Living alone, it couldn't have been a family member – and, having run a virus check, he couldn't see any signs of malicious code. Perhaps it was just a case of mistaken identity, he thought. Or maybe someone had managed to gain access to his wi-fi network.

Unfortunately, his second hunch was correct. A neighbour had been using his network to download films and games, and he was mightily upset. He was right to be; someone with access to a wireless network can compromise a host of devices these days, ranging from computers and phones to cameras, smart televisions and connected appliances. An unprotected network can allow people to see the content of the data being transmitted back and forth, and it can let them view your private information.

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"Welcome to the future: cloud-based WPA cracking is here!" - TechRepublic

"Low cost service cracks wireless passwords from the cloud..." - TheRegister

"This really is a great idea." - Hacker News

There is a surprisingly wide range of tools available to anyone looking to hack a wireless network

It can also, as the friend saw first-hand, allow others to download illegal content or infect a machine with spyware or viruses.

That's just the start, though. Compromised networks can be used to send spam and viruses to other people too, with the added danger of the offence being traced right back to your door. Indeed, as if to underline the effects of a hack on an unsecured network, you only have to cast your mind back to November 2015.

You may well have missed this piece of news, but the *Herald Scotland* reported that the comedy duo the Krankies lost £3,000 to fraudsters when their home wi-fi was compromised, apparently by a man who parked up outside in a dark saloon. They are not alone either, as security company Avast says around 75% of households are at risk of attack via a wireless router.

While hacking wi-fi may not be the easiest thing in the world to achieve – it requires patience, some technical skill and decent software (most of the stuff online is packed with cookies and malware) – there is no point in tempting fate. You'll do yourself a lot of favours in the long-run

How The Hackers Operate

Hackers looking to breach a home network have an easier time of it thanks to the number of devices that are now hooked up, providing a greater number of entry points. Devices such as smart televisions, with fewer network restrictions, are viewed as easy ways in but, as always in these things, we users are often the weakest link – so make sure you put up the right defences and watch out for any potentially dodgy downloads in emails and online.

Experts say the problem is only going to get worse thanks to the wide availability of simple software that can be used to access networks. Aircrack-ng, for example, works with a wireless card and actually has step-by-step instructions showing users how to discover network passwords. WEPCrack is an open source tool that lets people break into 802.11 WEP secret keys, while AirSnort bills itself as a wireless LAN encryption key recovery tool that passively monitors transmissions, computing the encryption key when enough packets have been gathered.

KisMAC for Mac OSX and Kismet for Linux need advanced knowledge but they will help to crack WEP and WPA keys by brute force, exploiting flaws including weak scheduling and badly generated keys. Yet, even without such specialist software, you can see which wi-fi networks are available thanks to built-in features in modern operating systems, and there are password lists around on the dark web that show the popular terms people use to log in.

Knowing that there is such support for hackers should make you more determined to shore up your machine and make it less vulnerable to attack. Experts suggest it takes mere seconds for a decent hacker to access a home network and a couple of minutes for someone using a tool downloaded from the web. The truth being: they are generally not going to such efforts for mere fun.

and sleep more easily if you secure your home wi-fi network. After all, you don't want any scam-dabi-dozis parking down your way in the future.

Access Your Wireless Router

So what should you do? The first thing you need to know is how to access the settings of your wireless router. This part is easy. Try typing 192.168.0.1 into the address bar of your browser (or check your user guide for the right number combo if this doesn't work), and log in using the username and password for the router. You'll find this within the manual, from your ISP or via a search online since the routers have standard logins which work across the board. Once you're in, it goes without saying that you really ought to be looking at changing the login details to something more secure and unique to you, and you can do this from the page that will appear on screen.

With that done, you can then look at altering the router's IP address as well. It may seem extreme but the router's default IP address can be known by others, so by creating your own bespoke address (as long as the numbers within the dots are between 1 to 254), you will have something unique and known only to you. Just remember, when you log in to access your router settings from that point on, you'll need to input that IP address in the URL bar of your browser rather than the one you started with.

Now take a look at the devices connected to your home network. You should be able to recognise each one of them, and if you can't then you may have an issue with someone piggybacking on your network. Not only will this pose a security threat to your network and zap some of your speed, if you're still on a contract that limits your data, then it could prove quite costly too. So, in order to avoid any such problems, let's take some action in locking down the wi-fi even further so that any rogue device finds it more difficult to gain access in the future – effectively chucking it off the system.

Should You Use A Router Supplied By An ISP?

It's the easy option. You buy a package from an internet service provider and you get a router. So why bother going to the expense of getting an alternative? In most cases, you'll generally be fine with the provided router, but they are usually less secure than the ones which are sold direct. With patches often coming later and with remote support hardwired into them, they can also be more inflexible. So if you want extra security and choice, then you may well want to find your own router.



“ **TKIP is no longer considered to be secure, making WPA2-PSK (AES) the safest of bets** ”

Don't Tell SSID

As well as changing the password of your router, take a look at the wireless network name, or SSID. In a lot of cases, this is quite descriptive of the service you use. Sky, for instance, will generally say SKY in the name and list a series of letters, and this is generally the case with a lot of ISPs. The problem with this is that the name gives a stark clue about the equipment you're likely to be using, and that will only help hackers in their endeavours to breach your security.

You can alter this by clicking on the option for changing the wireless network name – but what to choose? It's best to go with something obscure that you will instantly recognise, while ensuring it doesn't give anything away about who you are and what kit you're using. This is mainly good practice rather than a strict method of security but in situations such as this, every little helps. If the name looks weird enough, it may put some people off from trying to gain access for fear that it's evidence you've locked down some other settings.

Enable Your Encryption

Your next step is to encrypt the data going back and forth. It is likely that you will already have encryption turned on (if you're asked for a password then it will be), but you have to be 100% sure because an insecure network is going to be far easier to breach. Also, there are different levels of encryption so you'll want to be using the correct one.

It is rather unlikely that your router will be set to WEP encryption. This is a very dated security protocol that was introduced some 20 years or so ago, when the IEEE 802.11 wi-fi standard was introduced. Today, it is the least secure form of encryption, and it is generally only used if you're wanting to hook older hardware to your network. It's definitely one to stay clear of, bearing in mind that poor encryption and sloppy configuration are the two key mistakes that allow hackers through.

Far better for modern use is its replacement – WPA – which has been knocking around for 13 years. It makes use of the Temporal Key Integrity Protocol and requires far greater brute force in order to prise it open. Even then there's something better, however: WPA2. This uses the Advanced Encryption Standard (AES), and it is far more secure than the other methods, requiring hackers to have a good idea of how the network is being used or to use specific software and tools to do the job.

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It's worth upgrading your router if it doesn't support WPA2 and ensure that it is checked as the preferred method. You'll likely see this listed as WPA2-PSK, the extra three letters standing for Pre-Shared Key. This refers to a shared secret which is typically your encryption password but if you are offered a choice of WPS2-PSK, go for the one with AES in brackets rather than TKIP. That's because TKIP is no longer considered to be secure, making WPA2-PSK (AES) the safest of bets.

Disable WPS

So what next? Well, you will be able to boost the strength of WPA2's protection by disabling Wi-fi Protected Setup, or WPS. This security standard was created to produce a secure wireless home network, and it manifests itself in one of two ways: either via a unique PIN or via a physical WPS button on the router. When the button is pressed or the PIN is entered, a link is created between devices. The idea is that to hack it, someone would need to have physical access to your router or be able to guess your eight-digit PIN. Yet, almost perversely, WPS can make your machine more vulnerable to attack.

The problem is that while the button-press method is the most secure of the two ways WPS works, the specification of WPS makes it mandatory for the PIN to be supported. All a piece of software has to therefore do is cycle through the combination of numbers and brute force its way into the network. This is also made much, much easier by the fact that

Remote-Access Trojans

One way hackers gain access to computers is via a remote-access trojan – a type of malware which allows attackers to infiltrate your machine and control it from afar. It requires the victim to unwittingly install the software, but once it's on a machine the attacker is able to view your screen in the exact same way as you can.

They can watch what you are doing, use their own keyboard and mouse to operate your machine, open apps, delete files and even watch what you're doing via a webcam or listen to your conversations via the microphone. It is why Facebook founder Mark Zuckerberg puts tape over the webcam and microphone of his Apple laptop.

The first thing you need to do when a RAT has infiltrated your computer is pull the plug on your home network by turning off the wi-fi and isolating the machine. You can then work on eliminating the problem by running a virus scanner.

While this is a different issue to a hacker brute forcing their way into your network, it nevertheless shows how home systems can be used against you. Always monitor your firewall settings and ensure you have up-to-date virus scanners installed on your computer and other devices.

the router checks the PIN in a very specific way – by checking it in two blocks of four. The software only needs to check the 10,000 four digit-codes possible in the first block before being able to do the same to the second set.

As well as significantly cutting the time it takes a hacker to get in to a system (it can take as little as an hour or as long a day) it isn't actually a hard task to perform. There are downloadable programs available for free that allow for such cracking, and the person using the app generally

doesn't need any specialist knowledge. The end result is always the same too: once someone is in your system, they are able to change your router or the configuration of the access point.

This makes finding a way to disable WPS useful, yet some routers won't allow you to do it. If you are lucky, then the setting is likely to be an option in your router's WPS settings so you should have a look around the administrative sections. It should be a simple case of unchecking a box.

“ You may have an issue of someone piggybacking on your network ”



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| Wireless Network Name (SSID) | SKY6A |
| Wireless Network Visible | Yes |
| Current Wireless Channel | 13 (2.4 GHz), 36 (5 GHz) |
| Wireless Encryption | WPA2-PSK |

Useful settings

- > Further Diagnostic Help
- > Change Admin Password
- > Disable or Enable Wireless Network
- > Change Wireless Network Name
- > Change Wireless Password
- > Change Wireless Channel
- > Change Parental Controls
- > Revert to factory default settings
- > Reboot Sky Hub

Devices connected to your home network

| Device Name | MAC Address |
|-------------|-------------------|
| UNKNOWN | b5:ff:0e:b5:ff:0e |
| JANES-iPad | b5:ff:0e:b5:ff:0e |

You should be able to gain access to details of how your wi-fi is being used via the router's settings

Turn Off UPnP

Now we'll turn our attention to a set of networking protocols called Universal Plug and Play (UPnP). This allows devices, whether they are computers, printers or wi-fi access points, to find each other and create a data-sharing network. Since UPnP devices are able to alter a few of the router settings without needing to be logged in via your browser, it only needs a hacker to introduce a device and exploit your network. For this reason, you may want to turn it off within the settings of your router.

That said, doing so could make your life a little harder. The feature automatically forwards ports that are needed for gaming applications. It allows for a reduction in lag and makes for a better experience. You'll have to weigh up whether there is a potential risk for you or whether your entertainment will suffer. Luckily, if you do leave it on there are other things you can do.

Filter MAC Addresses

Everything you connect to wi-fi will have its own unique MAC address. Standing for Media Access Control, it is used as an identifier, and it is made up of six pairs of characters, each of

“ A compromised network can be used to send spam and viruses ”

which is separated by a colon. By discovering the MAC address of the machines and devices connected to your network, you can restrict your router so that it only works with them. All you need to do is input the MAC addresses into the relevant settings area of your router. But how do you find out what they are?

In Windows, this is simple: open the command prompt by right-clicking on the Start button, type `ipconfig/all`, and press Enter to see your network configuration. By scrolling down to your network adapter, you should see a set of values listed next to Physical Address, and this will be your MAC address.

It's just as easy on an Apple Mac: select System Preferences, click on Network, and click on the connection you use (so select wi-fi), select Advanced, and then click the Hardware tab. The MAC address will be displayed.

You can also locate the MAC address in Linux by ensuring you're the root user and typing `ifconfig -a`. You then need to find `eth0`

and locate the number next to the HWaddr. This is your Mac address.

Of course, you're not just dealing with computers these days. On iOS, you can find MAC addresses by heading to Settings > General > About and looking for the entry next to wi-fi Address. In Android, you'll go to Menu > Settings > About Tablet > Status and look for the wi-fi MAC address.

Inputting a MAC address is not a foolproof method by any means, though, so you should only do it as one of the many lines of defence of locking your network down. The issue here is that there are a few apps around including Nmap which are able to discover the MAC address of any wireless device. Hackers can then use another app to alter their machine's address to match it and gain access but it will take a pretty determined hacker to be going down this path, in which case we're going to have to up the ante a little bit more.



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As the Internet of Things grows, securing your network is becoming more and more important



Stifle The Range

One way of doing this is to limit how far your wi-fi signal is extending from your router. If we take the example of the Krankies again, it appears they may have been stung by someone sitting outside their house and accessing their network. It is also possible for neighbours to discover nearby wi-fi and attempt to connect in a similar way – you only have to look at how many wi-fi signals there are in your area, especially if you live in a shared building, to see how strong some of them can be. So is there a way of limiting the range?

You could move your router to the centre of your house. It will have a specific range so there will naturally be certain areas outside your home that will have a stronger, wider signal than elsewhere. Having a router close to an external wall will mean the signal stretching far outside.

You can also reduce the power input on some routers, which will temper the signal, or you can look to get hold of some directional antennae. It's shame you can't just tell the router to limit to, say, 20 feet, but give those two tricks a try anyway.

Keep Updated

It is also important that you keep on top of the firmware updates from the router manufacturer. You'll either have to download it yourself and manually install it or simply click – it very much depends on the router you have. Before you do this, make sure that you have a backup of your router settings just in case it is reset to the factory default.

By following these tips, you should be able to rest a little easier knowing you have a more secure network. There are still some other things you can do,

though. Some experts would advise that you turn off the setting for your router that broadcasts your network's name – only the hackers with specialist software will be able to find it, leaving it invisible to everyone else (but that also means guests will have to know what to look for). You should also enable the firewall so that it blocks unsolicited incoming traffic and protects the network from the 'wild' internet. Some routers will also allow the blocking of some outgoing traffic.

You could also get into the habit of turning the router off when you leave the house. If your wi-fi is not needed when you're out and about this would be a surefire way of blocking the hackers.

Granted, it won't be as useful if you are starting to hook into the internet of things and you're looking forward to turning the heating on in your house just before your drive home. Neither will turning it off be a good idea if you want to light up your home remotely to make it look like someone is in. However, with attacks becoming more sophisticated, you can't be too careful, and sometimes compromises have to be made.

A BBC article in February 2016 showed just how easy it can be for hackers to compromise a network and gain access to various devices including cameras, which are often used to spy and eavesdrop. We're only at the start. With more and more devices hooking up online, the number of vulnerabilities is set to rise over the years too. You just never know who may be watching. [mm](#)

Find A Manual For Your Router

If you need to refer to a manual, then you should be able to find details online. Here are some handy links.

Netgear: netgear.com/support

Linksys: linksys.com/us/support

BT Hub: tinyurl.com/zgqbcxo

Sky Hub: sky.com/help/articles/download-sky-broadband-user-manuals

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HOW TO CALIBRATE YOUR MONITOR

Get the most out of your display with a few simple steps

Since you're reading this, the odds are good that you've probably never given your monitor's display settings that much thought. Don't worry, you're not alone; many PC users have display settings that are the same as when they first turned on the system. It's common to accept the default settings, and it's often only users who actively concentrate on image quality that would notice minor differences and make an effort to change things. The simple fact is that the out-of-the-box settings are perfectly fine for most. However, even if you're of this opinion, you're likely missing out, and you could make your display look so much better with very little effort.

This process is called calibration, and it involves fine-tuning the colour, contrast and gamma settings of your display to get the best possible range of colours and most accurate blacks and whites to produce the best picture. It's simple enough, but calibration is more accurate than simply changing settings and trying to see what's better; it often gives you the chance to see how each change

specifically alters your display, as well as letting you compare a new setup with your previous one to see which is best.

Is It Worth It?

Before we look at monitor calibration in more detail, as well as the tools you can use to give it a go, we should consider the benefits and if you should try it.

The main reason to calibrate your display is simply to see images as they're intended to be seen, and that's with the best balance of colour, brightness and contrast. For users, this will mean you're seeing games, movies and just everyday content in the best possible way.

This is good for any users who value visual fidelity, even in passing, but it's essential for users who absolutely need the best possible image reproduction, such as graphic designers, artists, video editors and so on. Even web designers, who need to make sure their sites look the best they possibly can on different displays and browsers, benefit from this.

Calibration is also useful when you buy a new monitor and find that everything looks different to

what you're used to when you come to try it out. By calibrating it, you can restore your display to how you like it.

Gamers will find a great deal of use for calibration, because the right levels are essential for delivering the right atmosphere in many games, especially those that play with light and shadow, such as horror titles. Many games prompt you to alter the brightness prior to play, such is the importance of this setting, so calibrating your display to be optimal from the off is a great time saver and a way to guarantee the best overall experience.

Other simple reasons to calibrate a display include creating a better base for print matching, correcting over-saturation on wide gamut displays and bringing colour reproduction back to a more lifelike level after many changes or unrealistic default settings. Displays can also change over time just from general use and wear and tear. Calibrating can return a unit to its reference state.

Certainly, the most important reason you'll want to calibrate your display is your own health – that is, the health of your eyes.

Running a display that's too bright, too dark or not optimised may mean you could end up squinting or struggling to see details that should be easy to make out. Paying attention to the correct settings can help you keep your eyes healthy too.

Simply put, if you want your monitor to look its best, whatever you use it for, you'll want to calibrate it.

Basic Calibration

There are many ways to calibrate a monitor, involving practical tips, built-in Windows tools and specialised solutions. We'll look at all of these, beginning with some practical tips that'll help any calibration, as well as ensuring you keep your display optimised on a day-to-day basis.

First up, we have the most basic tip, and that's to keep your screen clean. It may sound like stating the obvious and, indeed, it is, but it's amazing how many users don't

On-screen Options

Although the Windows calibration tool allows you to utilise simple sliders to alter the display properties, as do GPU control panels, this isn't always the best way to control your display's settings.

Instead, it's often better to use your monitor's actual controls and not the OS. Depending on your model, these controls may be located on the physical unit itself, accessed via an OSD (on-screen display) or both. Using these, you can directly change your monitor's settings. Some monitors even have built-in calibration tools, which means you're best off using these at first.

Used in conjunction with the tools we've looked at here, including the Windows wizard, this is usually the best way to get the most accurate settings. Always check your monitor for such tools, and don't be shy about giving them a go.

regularly clean their displays, even when they become dusty, splotted with coffee and generally covered in a layer of detritus. Often this isn't even all that visible due to the bright colours of the display hiding many stains. This is likely why many don't clean their displays often, because they think they're clean.

However, just like you're amazed when you finally get round to

dusting off your TV to find a bright, clear image underneath, so too will you be impressed at the difference a clean monitor can make. In some situations, you may not even need to calibrate at all.

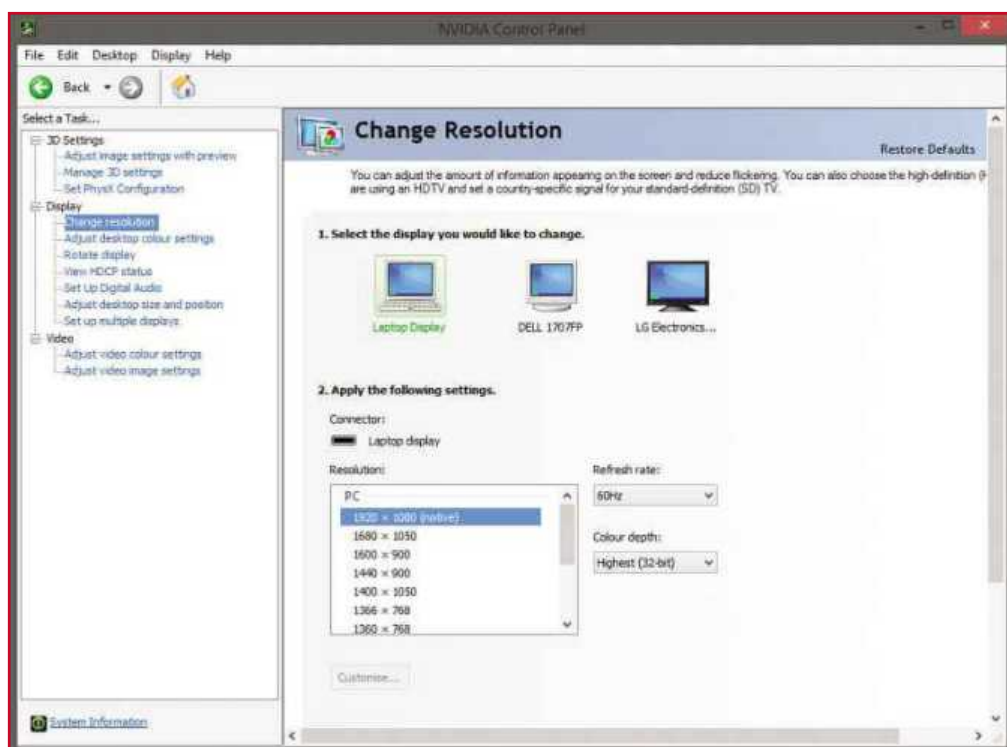
A big reason a lot of people don't clean monitors, especially since the rise of flat screen, LCD, plasma and LED monitors, is because they're unsure of actually how to clean such screens. There's a lot of concern over damaging a screen or using the wrong substance to clean with. This needn't be a problem, though, and it's very easy to do.

Although you can buy any number of monitor cleaners and solutions, most of which can be used safely enough, you really don't need to. A slightly damp cloth with distilled water (not tap water) is perfectly fine, and gently sweeping it over your display will usually be enough to clear any minor dirt and splashes. Just ensure the cloth is only very slightly damp, not enough to cause drips. Dry the screen off with a non-static and non-abrasive soft cloth. Do this with the power off, of course.

When wiping the screen, gently move in small circles, and avoid using materials like paper towels and dish cloths, because they're just too abrasive. A cotton cloth (even an old T-shirt), or microfibre or specialised cleaning cloth are ideal.

You can make your own cleaning solution if you like using water with a little isopropyl alcohol or white vinegar. Don't mix them, however, and ensure you only use one or the other. Avoid any powerful cleaning

“ Certainly, the most important reason you'll want to calibrate your display is your own health ”



▲ Nvidia GUI: GPU control panels will advise on the correct native resolution

products, especially those that contain ammonia. Window cleaners and most household cleaners are to be avoided at all costs.

With a clean screen, you'll not only have a generally better display, but when it comes to calibration, you'll know you're working from an optimal screen. This is good practice before any calibration.

Next, ensure you're using the monitor in the best lighting conditions. This means avoiding any glare from lights or sunlight from windows. Don't use the monitor in a dark room, but ensure the light isn't bright enough to interfere with the image on screen.

It's now time to consider the monitor's actual setup. By this we mean drivers and resolution. Before any calibration is performed, it's wise to get the latest graphics card drivers, including any updated control panel software they may have. If you're using actual drivers for your monitor, not just Windows' generic PnP monitor drivers, also make sure they're up to date. Different drivers for either the monitor or GPU could affect the display, so it's good to be working from the latest versions.

Resolution is very important, and not all calibration options will enforce this (including Windows' own). All monitors have their own 'native' resolution. This is the resolution they're designed to work in and which will deliver the optimal, crisp and clear images. This is often the maximum resolution a monitor can support, although this may differ depending on specific models and combinations of graphics cards. Consult your documentation to find out what your display's native resolution is if you're not sure. Many driver packages, such as Nvidia's control panel, will list this in the options. Running the wrong resolution will not give you the optimal starting point, and your calibrations won't be as accurate as they could be.

Finally, set the proper colour depth of your display, as well as the refresh rate. For most modern displays this will be 32-bit True Colour, and the refresh rate will

vary depending on your hardware. You'll need to check this. You should also ensure your monitor has been on for a while, 30 minutes to an hour, so that it's fully warmed up and is running as it would in general use.

With these settings taken care of, calibration can begin, and we'll look at the Windows built-in option first.

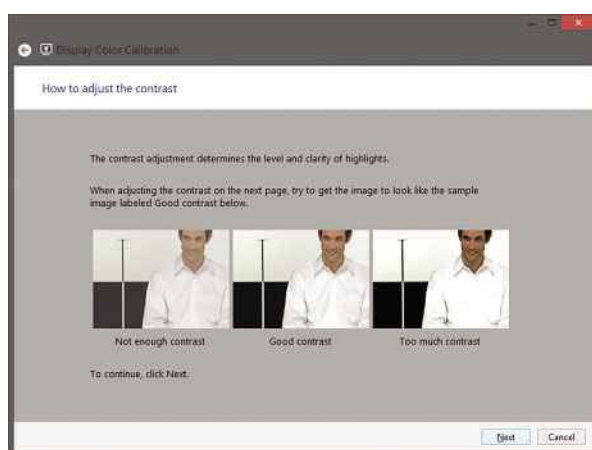
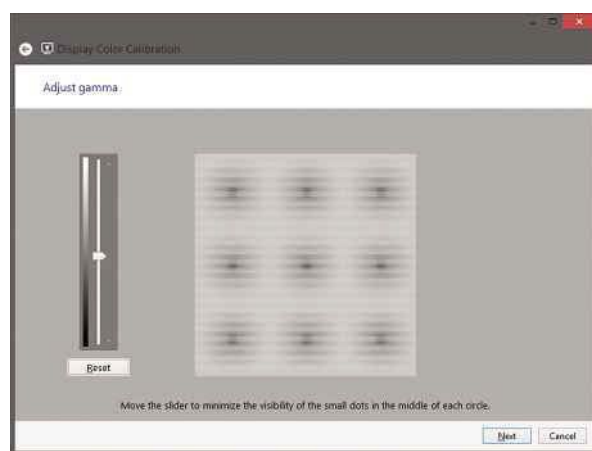
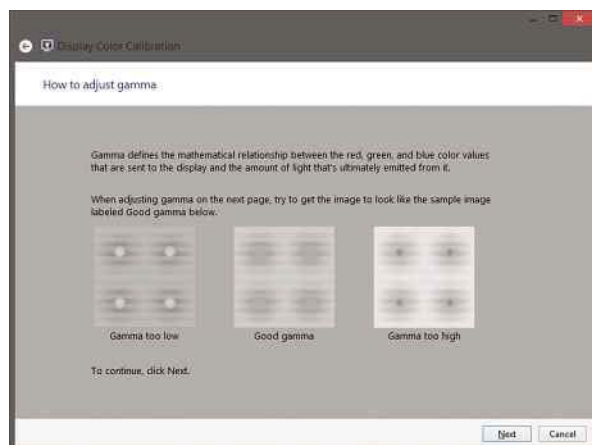
Windows Calibration

Windows has its own calibration tool, and although not the most in-depth solution, for most users it's probably the most suitable option. It requires no extra cost or download and is very easy to use.

To kick things off, simply press Win+R and type 'dccw', then press Return. This will open Windows' calibration tool, which will pretty much lead you hand in hand through each step with some helpful images, but let's take a look anyway.

1. The calibration tool is a simple wizard you need to step through, and it gives you sample images to help. However, it may also be a good idea to have an image or video still you're familiar with on screen too to help you get a better handle on the settings.

2. The first step involves a simple gamma adjustment. As the wizard explains, gamma is basically the mathematical relationship between the three primary colours: red, green and blue. The tool provides an image showing four 'dots'. These are actually a visual trick caused by the image geometry that's altered by the gamma setting to produce the dot effect. The ideal setting here is a larger, less defined centre and not a defined small point. It's easy to get carried away here, and you can end up turning the image into more of a seeing eye picture. Don't get too hung up on the dots, and don't start staring at them, otherwise you'll see them no matter what the setting. Instead, casually look at the display, even turning your head away and back. Set the gamma so the passing glance closely resembles the image in the middle example. Clicking Next will let you do this using a larger version of the image and a simple slider. Move the slider



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White point

An often overlooked setting when calibrating a monitor is the unit's 'white point' or colour temperature. This deals the appearance of whites and utilises theories on the reflection of light wavelengths off of black objects at different temperatures.

It's said there's no such thing as pure white and all light sources have a colour hue to them, which affects the white glow they emit. This includes monitors, and the colourful hue emitted by the white changes depending on the temperature. For example, the colour temperature in Kelvin of a TV is usually 6500-9300. This radiates a blue hue, which is why TVs through windows often appear to give the room a blue glow.

This temperature is not an actual heat measurement, but is instead a measurement of the colour hue of a white light under specific heat conditions, which is reproduced by the display.

Users debate which is the best overall setting to use, with most users who have to look at images and moving objects going for the setting D650 (6500), the same as used in TVs. People who do a lot of reading or writing work often go for a more neutral option of D50 (5000). Again, experiment using your display or GPU's settings to find the best option for you.

until you're satisfied the image is as accurate as possible.

3. This format continues, with a sample image before the actual change, with the next being the brightness level. This is more of a concerned change, so you'll need to pay more attention to the actual detail here, focusing on the details in the image and if the scene is too dark to see the detail or so bright it's muted and too white, causing blacks to be greys.

4. Next comes the contrast, which deals with highlights. Again, this setting is all about looking for detail and texture, this time on light-coloured objects. Too much contrast and details will simply be lost in the glare; too little will wash everything out. As before, get the image as close to the middle sample as possible and move on.

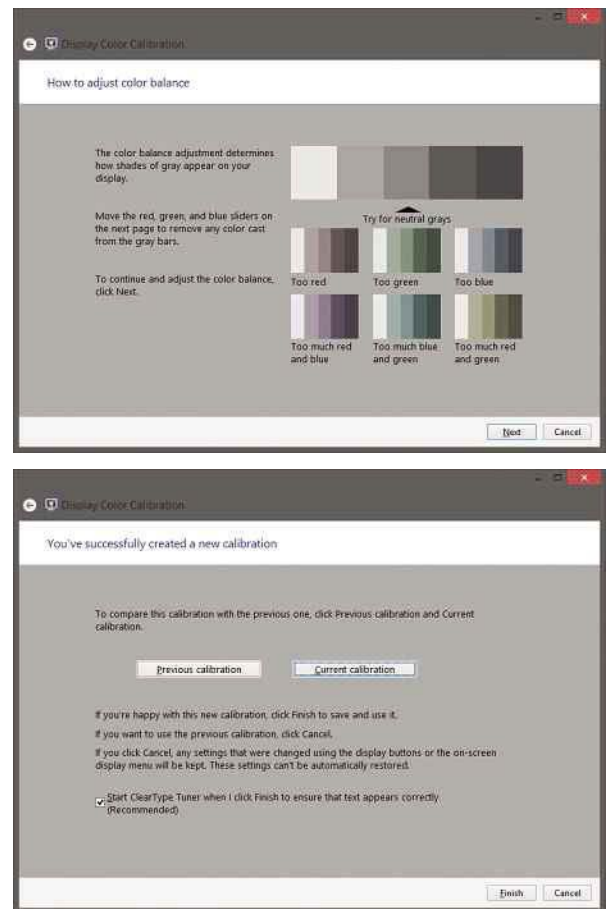
5. Finally, we have the colour balance. This is measured here using greys, which need to have the right amount of primary colours to look grey, and not saturated with any colours that are too strong, affecting the grey tint.

6. Once you're done, the last screen will present you with two buttons: one for the new calibration and another for the old. Clicking these will instantly alter the image to a before and after state, so you can easily see the change. This is when your own

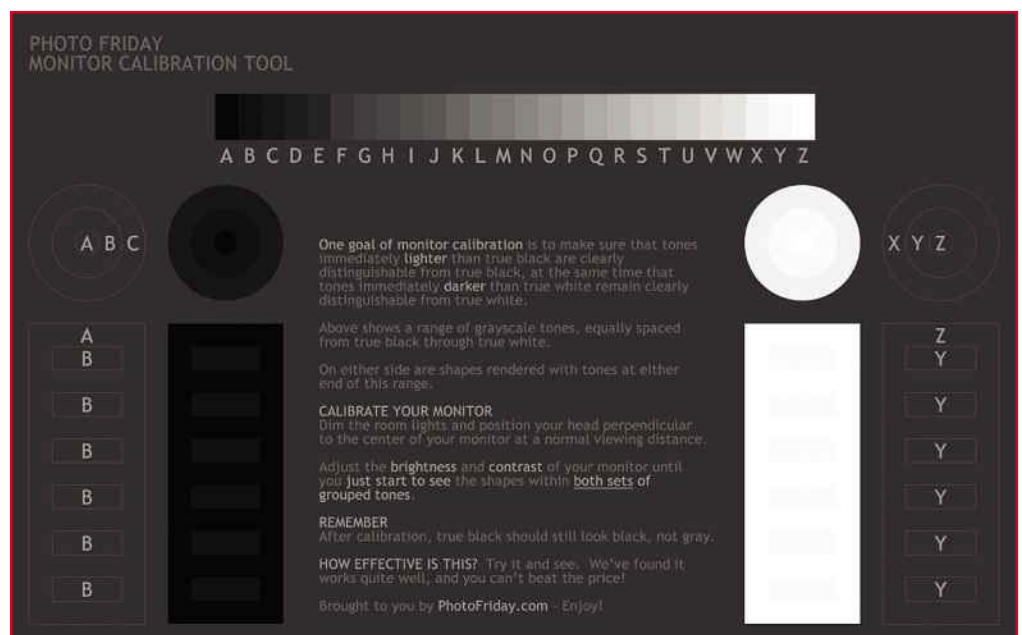
sample image or video will come in. Bring up the image or video and click the buttons to compare the configurations. Select the one you want to go with and then click Finish. You can then see the ClearType Tuner if you like to play with the font settings.

Specialised Tools

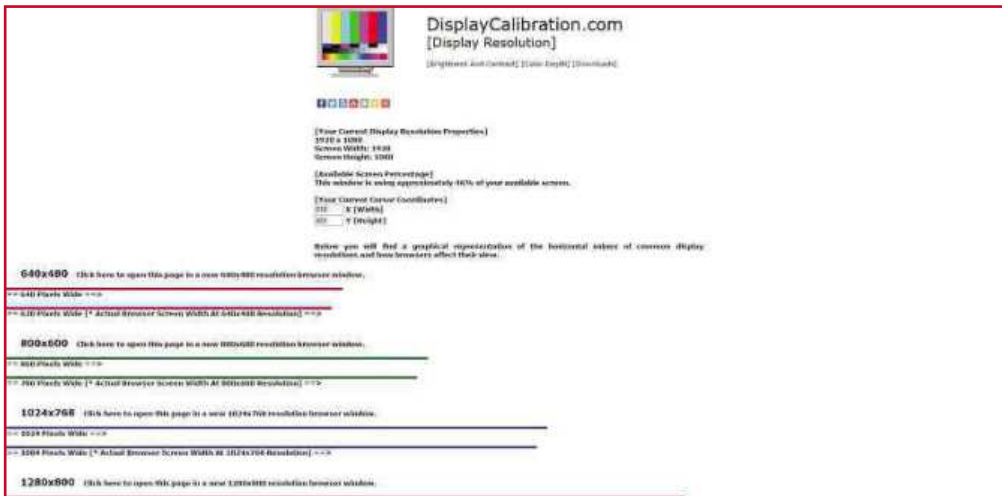
If you'd prefer a little more in the way of options and need software that's more specialised for this task, you may already have some installed but don't know or realise



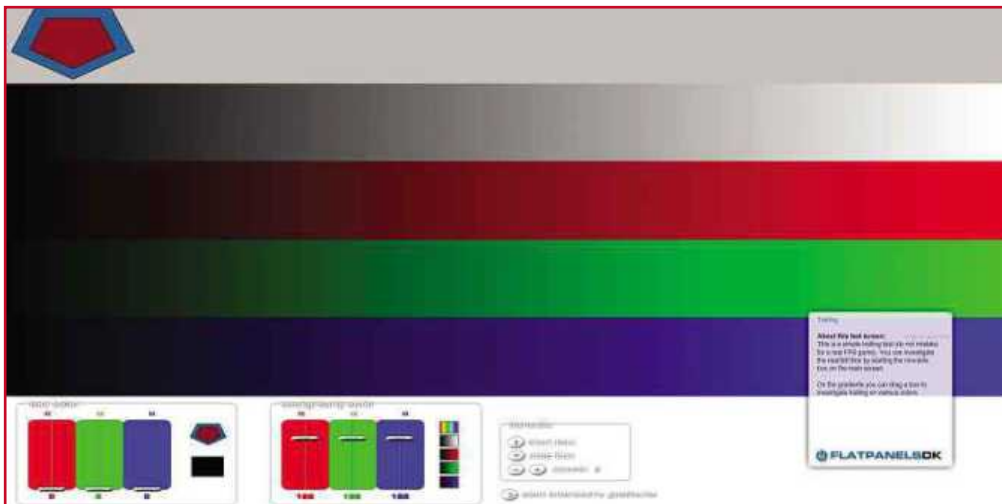
“It’s amazing how many users don’t regularly clean their displays”



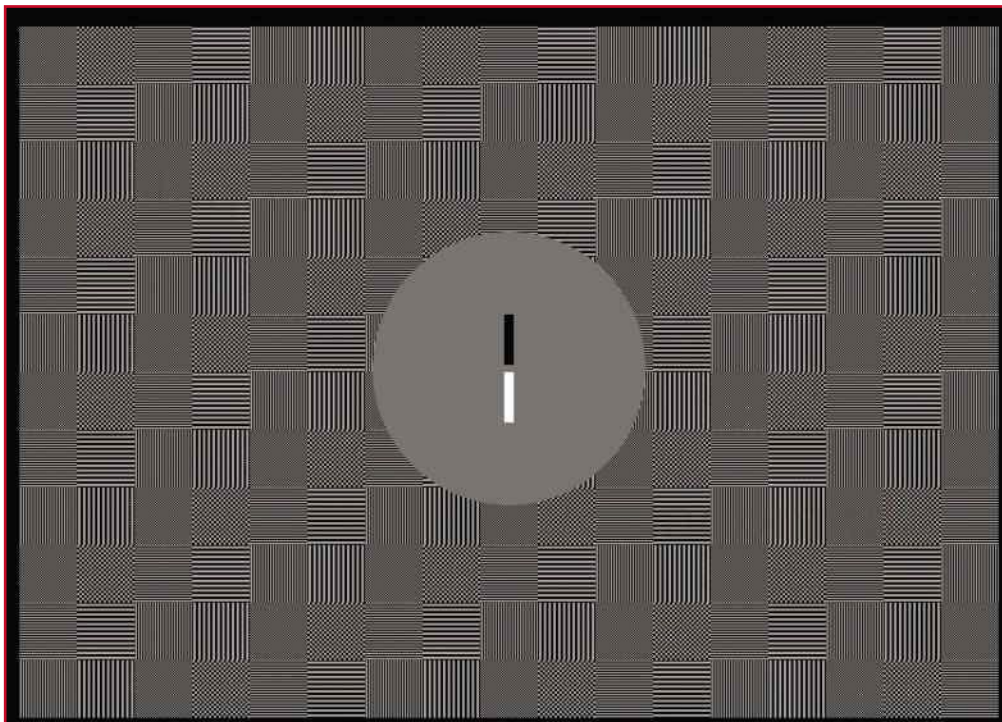
▲ PhotoFriday offers a simple test card to help calibrate your display



▲ Display Calibration is useful for all, but especially for web designers



▲ The FlatpanelsDK test is a great way to calibrate your monitor



▲ The images at www.lagom.nl/lcd-test can help greatly when calibrating your display

it. For example, Adobe Photoshop, which has been widely available in both paid and free editions, has its own built-in gamma tool. True, this is an older option that was designed mainly for now defunct CRT displays, but it's still of some use, and because it's designed to accompany an image editor, it may be of more use than Windows' version. It has both a wizard and a more advanced control panel mode, so it's good for more advanced users. Other image editors or design packages may well have their own tools, so check them out.

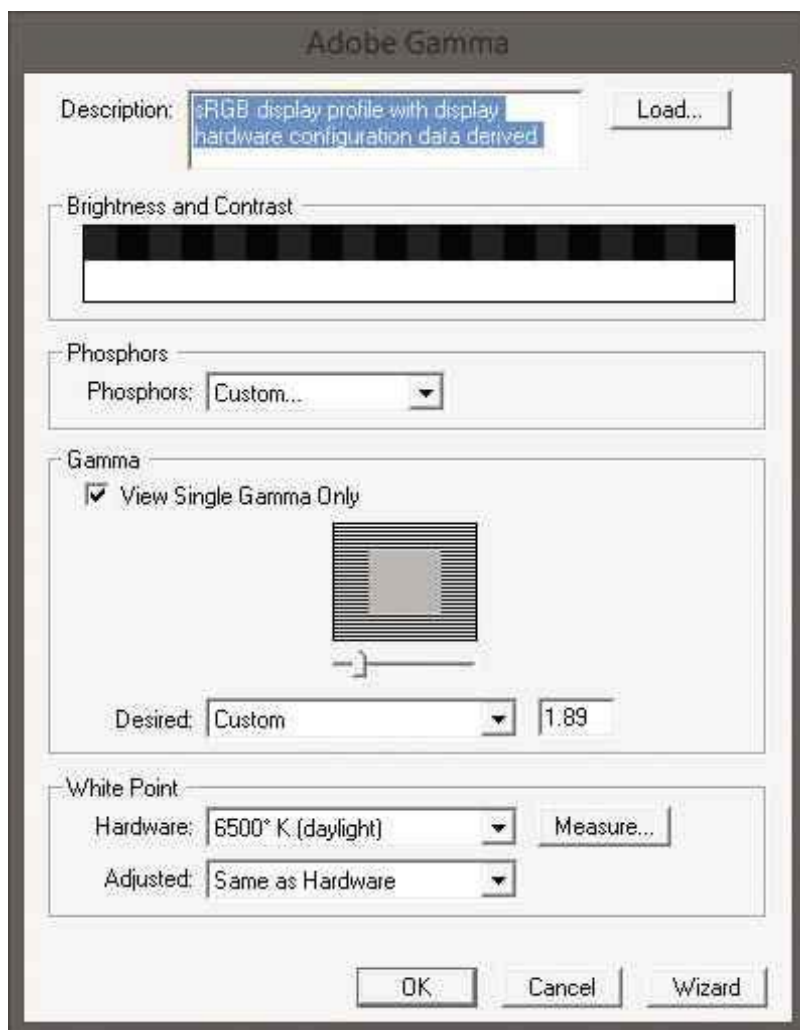
For more dedicated options, it's a good idea to take a trip online, as you can find many online tools that will let you perform a calibration without the need to download software.

PhotoFriday (www.photofriday.com/calibrate.php) is one such option. It isn't a service per se, but instead offers a simple calibration image that you can use when adjusting your monitor's own settings. It's a test card, essentially, which features a focus on black and white and getting the perfect balance between the two extremes to distinguish each clearly.

DisplayCalibration (displaycalibration.com) is a more hands-on option and, like the Windows function, it provides a variety of tests that let you instantly alter the website shown, such as changing the background colour and seeing how it affects your perception of all colours and shades in terms of brightness and contrast. There's a handy resolution tool that includes pixel measurements and visual aids on screen size, even showing you the coordinates of your cursor.

This site is focused on web page appearance and therefore is a perfect test for web designers. The resolution measurements are even useful outside of display calibration, for example, knowing how much of a page visitors to your sites will see depending on their monitor settings.

FlatpanelsDK Interactive Monitor Test (tft.vanity.dk/monitorTest_scale.html) is one of our favourites. It's a very thorough collection of interactive screens



“ As human beings, we’re all different, and we’re all prone to errors. We also all have totally different eyesight and see things and colours differently ”

that help you pick the best possible settings, from brightness and contrast, to gradients and testing screen trailing. Each tool has a description to let you know what it’s designed to test for, and there are even various animated tests, a tool for detecting dead pixels and a backlight bleed tester.

It’s a really useful site and a very handy bunch of tools for a wide range of users, from casual to expert. It’s well worth a look.

Finally, if you visit www.lagom.nl/lcd-test, you’ll find a selection of separate images that can help, much like the test card arrangement used in other sites and services. These all deal with specific aspects of display calibration, such as saturation, contrast and sharpness, as well as performance elements like response rate, viewing angle and subpixel layout. All are very useful to have on hand. mm

Hard colour

Even with various software tools and aids to help configure and calibrate your display, there’s one potential problem that affects them all and could introduce errors regardless: us.

As human beings, we’re all different, and we’re all prone to errors. We also all have totally different eyesight and see things and colours differently. In most situations, this isn’t a problem. Red is red, green is green, and blue is blue for the majority who aren’t colour-blind or have other visual conditions. However, even those with perfect vision may perceive the slight changes made during a calibration differently.

To combat this, it’s possible to purchase hardware-based colorimeters that automate the entire process, which designed to perfectly produce the optimal display. Some of these are simply plug-and-play USB devices and require no technical knowledge whatsoever.

Sadly, these devices are also usually quite expensive, so much so most home user budgets simply can’t justify them. There are cheaper options, but even then it’s a questionable purchase for more casual users.

However, if you require visual perfection for your hardware, either for work or just an obsessive need to have the best possible picture, and you’ve got the spare income to cover the cost, this could be the perfect option.

Datacolor has a range of USB Spyder units. The cheapest of these is around £90 and is the Spyder5Express. It’s a plug-in SB model that does the job for you with ease. The X-Rite ColorMunki is a little cheaper, costing around £80, and is also a very useful little device you can use if you’d like to have the calibration handled for you.

These units have obvious benefits for colour-blind users too, as the automatic nature takes any guesswork out of your hands.



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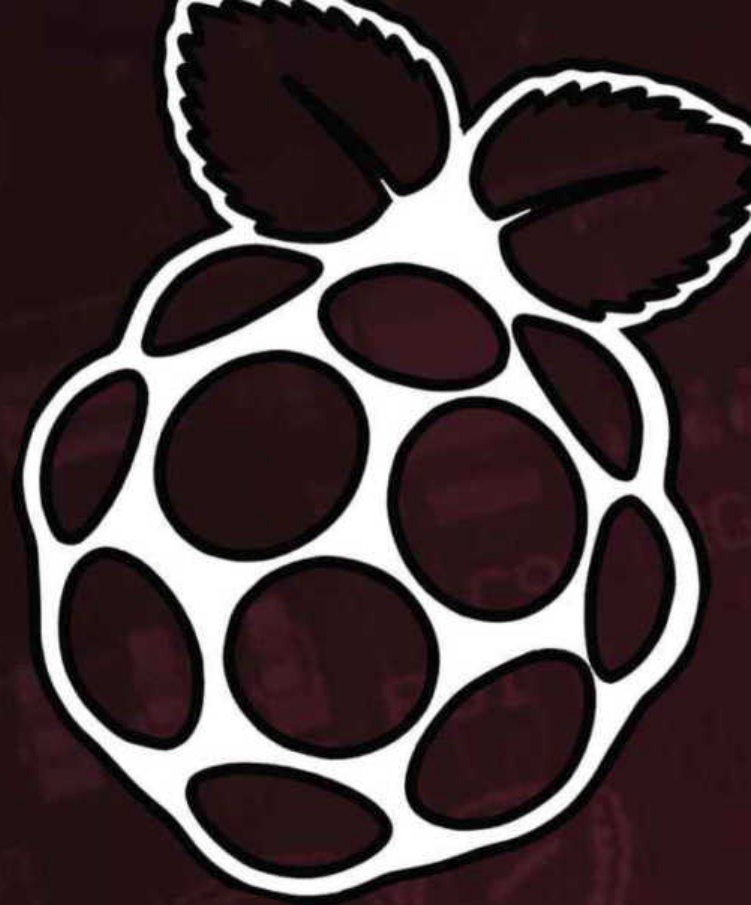
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UBUNTU MATE ON THE RASPBERRY PI

David Briddock explores the potential of using this stripped-back operating system on your mini computer

The low-cost Raspberry Pi boards are brimming with latent potential for fun and experimentation. Knowing this, it's no surprise that the A and B models have sold in the millions – far exceeding the Raspberry Pi Foundation's wildest dreams.

Yet when it comes to desktop performance the single-core BCM2835 processor is a bit of a disappointment. It simply can't match even entry-point-PC levels of performance. Consequently, Pi owners need a lot of patience to use those heavyweight home/office applications. Even opening too many browser tabs causes things to slow down substantially.

This lack of computing power also proved problematic for those wishing to install alternatives to the official Raspbian operating system. Installing and running a typical desktop Linux distribution, including the very popular, feature-rich members of the Ubuntu family, was pretty much a nonstarter due to their large disk and memory footprints.

Yet today, thanks to new additions to the Raspberry Pi family, it's a very different story.

“ **Ubuntu MATE is a good match for lower-powered PC hardware** ”

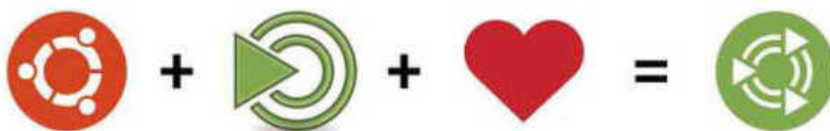
Pi Power

The launch of the Raspberry Pi 2 in 2015 gave a much-needed performance boost to Raspberry Pi family. With its BCM2836 System-on-a-Chip (SoC), a quad-core ARM Cortex-A7 running at 900MHz, the Raspberry Pi 2 outperformed the Model B+'s 700MHz single-core BCM2835 processor many times over.

This year the Raspberry Pi 3 appeared. The Pi 3 has an even more powerful 1.2GHz Quad-Core ARM Cortex-A53p,

which means it's around 10 times faster than the original Model B and quite a bit faster than the Pi 2. Flexibility is also enhanced thanks to the Pi 3's built-in wi-fi capabilities, which include both 802.11 b/g/n Wireless LAN and Bluetooth 4 (which supports both Bluetooth Classic and Bluetooth Low Energy).

Armed with a Pi 2 or Pi 3 board you have the basis for an everyday computing platform. Of course, you still need an operating system. The official Raspbian





debian

Jessie distribution is undeniably a great choice. It's optimised for the Pi's CPU and GPU chips, has a comprehensive list of pre-installed apps, built-in support for the GPIO pins plus coding tools like Python, Scratch, and Sonic Pi.

The Raspbian experience is even better when it's paired with a Pi 2 or Pi 3. But the extra power provided by these boards open the door to some new operating system choices. This includes some members of the Ubuntu family.

Ubuntu MATE

On Intel-based desktops, Ubuntu is one of the biggest names in Linux. It arrived on the scene in 2004 and like Raspbian is based on the rock-solid Debian Linux distribution. Earlier this year Canonical, the maker of Ubuntu, released version 16.04 LTS of the Ubuntu operating system.

While there are many members of the Ubuntu family (see boxout), the one we're interested in here is Ubuntu MATE. While built on the same main Ubuntu 16.04 LTS image, Ubuntu MATE is a little different from the standard edition of Ubuntu. In particular, it swaps out the rather heavyweight (as in very CPU and memory-hungry) Unity desktop interface for a rather less demanding graphical user interface known as MATE.

This makes Ubuntu MATE a good match for lower-powered PC hardware. Even so the Raspberry Pi Model A and B boards, with their single core 700MHz processors, simply weren't powerful enough to provide a good user experience.

However, when the Pi 2 appeared in 2015 the Ubuntu MATE team (ubuntu-

Mark Shuttleworth And Canonical



Mark Shuttleworth, the South African entrepreneur, was always intrigued by the potential offered by the Linux operating system. In fact, he was a member of the developer team working on the Debian Linux distribution during the 1990s.

Always a keen advocate of the open source philosophy, in 2004 Shuttleworth founded the Canonical organisation and dipped into his own substantial funds to develop Ubuntu Linux through the Ubuntu Foundation (community.ubuntu.com). This community encourages members to develop new system software, find and fix existing bugs,

write documentation, help with language translation, contribute to use interface design or create graphics, backgrounds and themes.

Shuttleworth is also known as one of the first self-funded space tourists. On the 25th April 2002 he became the first-ever South African in space when he flew onboard the Russian Soyuz TM-34 to the International Space Station; at a personal cost of \$20 million. He spent eight days participating in ISS experiments related to AIDS and genome research.

He also flies around in a Bombardier private jet, which is actually owned by his HDB Venture Capital company. It's not hiding that fact either, as it has the company's dragon mascot emblazoned on the side of the plane.

CANONICAL™

“ **MATE is a relatively lightweight yet richly functional Ubuntu Linux desktop environment based on the GNOME2 desktop** ”

mate.org/team), led by founders Martin Wimpress and Alan Pope, decided it was an ideal opportunity to port Ubuntu MATE to the Raspberry Pi platform.

The end result is a Pi-friendly version of Ubuntu MATE (ubuntu-mate.org/raspberry-pi) that's specifically designed to full advantage of the more powerful Pi 2 and Pi 3 boards.

MATE Installation

Before we start, however, let's make something clear: installing Ubuntu MATE isn't going to be as simple as using NOOBS, the straightforward image installation utility created introduced by the Raspberry Pi Foundation. Don't worry, though, it's not that difficult either. In fact, it's no more difficult than the steps needed to install the official Raspbian image, or any other supported operating system, before NOOBS

came along. What's more, you'll learn plenty of Linux tricks along the way.

On the dedicated Pi-specific web page (ubuntu-mate.org/raspberry-pi) the Ubuntu MATE team recommend using an 8GB microSD card. This is because the distro image requires a 64MB boot partition (FAT16 format) plus a 3.60GB root partition (ext4 format), leaving no space for user apps and data on a 4GB card. Ideally it should be a Class 6 or Class 10 microSD card to ensure compatibility and help with read/write performance. It's also a good idea to first reformat the microSD card to maximise root partition space. This can be done with a tool like GParted (gparted.org).

Note that you'll need to byte-copy the MATE image to the microSD card. On a Linux PC this can be done directly using a utility like 'dd'. Although on its webpage



the MATE team suggest the 'ddrescue' utility is a better choice. If you'd rather use a graphical interface tool instead of the command line then the GNOME Disk utility (tinyurl.com/j2zga5d) is a good choice as its 'Restore Disk Image' option natively supports XZ compressed images.

If you're preparing the microSD card on a PC running Microsoft Windows, rather than Linux, then you'll need both a decompression tool and an image writer. Popular choices are 7-zip (7-zip.org) to extract the image and Win32 Disk Imager (tinyurl.com/gtq6zso) to write the image to the microSD card.

Extra setup options include resizing the partitions to increase user space on the microSD card, toggling the MATE graphical user interface on or off (in case you want to run in server mode), plus some video optimisations. They're all described on the same Pi-specific web page.

With a Raspbian image there's a pre-configured 'pi' login user. With Ubuntu MATE you'll have to create an account and password as part of the setup process. But this is easy enough to do, just follow the instructions.

MATE Features

The Ubuntu MATE distro is brimming with apps and tools. One highlight is Caja, a file management app that's on a par with the popular PCMan, although maybe not quite as feature-rich as Nautilus, the desktop Ubuntu default app. Also worthy of note is the Pluma text editor, which is at least as functional as LeafPad; possibly a slightly more stylish, too.

There's much more, though: Mozilla's Firefox web browser and Thunderbird email manager are just a click away, as is the LibreOffice suite. MATE also excels in the multimedia domain with big-name video apps like Kodi, OMXPlayer, Totem, OBS Studio and VLC. The Rhythmbox music player and the Shotwell photo manager are also pre-installed.

As you might remember, one of the major differences between the Pi 2 and the newer Pi 3 is that the Pi 3 has built-in wi-fi and Bluetooth. The good news is that both of these wireless technologies are fully supported in Ubuntu MATE.

For those seeking interactive creativity and coding tools, the MATE distro includes Scratch, Python (with IDLE), C/C++, the music coding tool Sonic Pi and *Minecraft*. As it's a Linux image you can install pretty much any coding language you like, including Java.

Raspbian Jessie Comparison

Raspbian only has to concern itself with the Raspberry Pi range of boards. This does give it the edge (so far at least) in terms of Pi-optimised performance. Speed tests show that Raspbian boots up much quicker, plus certain heavy-duty apps, like LibreOffice, also open faster. However, for general usage, there isn't much in it.

In particular, Raspbian's educational credentials shine through. There's a wide range of pre-installed coding languages and tools – and, of course, the Raspbian community is huge, diverse and highly knowledgeable, resulting in an impressive collection of Pi-centric magazines, books, advice, tutorials, videos, and information.

Raspbian also shines in the important area of initial setup and configuration. The pre-defined 'pi' login user plus easy-to-use config menu certainly helps younger Pi enthusiasts and those lacking any Linux experience. It's rumoured, however, that a future MATE release may include a rather similar looking config menu.

This means getting the most from Ubuntu MATE can be a little more of a challenge. This can be seen as a good thing, however, as you'll be gently pushed

“ **Ubuntu MATE has a slicker and more polished user interface than Raspbian's LXDE-based alternative** ”

Ubuntu Family

Originally forked from the Debian distribution the first Ubuntu release occurred in October 2004. Today the Ubuntu family spans desktops, tablets, smartphones, servers, the cloud and even Internet-of-things (IoT) devices (ubuntu.com).

Right from the beginning the Ubuntu team committed to a new release every six months, one in April and one October. Releases are numbered using the digits of the year and month, so this year we've already seen the 16.04 release and by October we'll be able to download and install 16.10.

Every two years an '04' image is given the title LTS. This identifies the release as a Long-Term Support candidate, which the team supports for at least three years (or five years for the server product). Unsurprisingly, LTS releases are particularly favoured by business users.



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into learning more about the sort of power and flexibility a full Linux operating system has to offer. After all, Ubuntu MATE does offer the taste of a fully configured desktop Linux experience.

In addition, Ubuntu MATE has a slicker and more polished user interface than Raspbian's LXDE-based alternative. MATE has rounded windows and more colourful buttons. More importantly, it's also vastly more customisable. There are numerous preferences for changing how it looks and works, meaning you can alter the desktop, windows and other aspects of the user interface and windows just by tweaking a few settings. The apps on MATE are familiar and powerful. In particular, Firefox is a far more capable beast than Raspbian's choice of the Epiphany browser.

Also, Ubuntu MATE is also a good choice for hardware hackers. The inclusion of the RPi.GPIO (pypi.python.org/pypi/RPi.GPIO) and gpiozero (gpiozero.readthedocs.io) Python libraries means it's a straightforward task to interface with the Pi's GPIO pins – which can, in turn, be attached home-brew breadboard circuits or Pi HATs, and interact with LEDs, buttons, sensors, motors and so on. The possibilities are almost endless.

In fact, the gpiozero library module doesn't just simplify programmable access to the GPIO pins. It also has built-in support for the picamera and the popular Sense HAT (goo.gl/uruoJf), ensuring you can recreate any of those Astro Pi project experiments (astro-pi.org) while running Ubuntu MATE.

Wrapping Up

Ubuntu MATE is a full and complete Linux distro aimed at a wide range of platforms. It is often viewed in the same light as distros like PCLinuxOS which offer a smooth transition from Windows or macOS to Linux. Consequently, it ranks quite highly in the Linux popularity charts.

If you decide to install the Ubuntu MATE 16.04 LTS release on your Raspberry Pi you'll benefit from an impressive range of ARM-chipset ported apps, utilities and tools, plus three years support. Also, if

MATE

MATE is a relatively lightweight yet richly functional Ubuntu Linux desktop environment based on the GNOME2 desktop. It's designed to be both familiar and intuitive to Linux newbies coming from a Microsoft Windows or Apple macOS background.

MATE includes a file manager, text editor, calculator, archive manager, image viewer, document viewer, system monitor and terminal. And everything can be customised via the control centre.

Ubuntu MATE 16.04 ships with MATE 1.12. This version has a redesigned MATE Welcome window, where apps appear in a 'Software Boutique' section. Each app also has an expandable/collapsible 'More Details' section for screenshots, source repository, website, platform and license information. Other notable changes include advanced multi-finger touchpad support and improved multi-monitor support.



GNOME

The GNOME open source desktop environment was originally an acronym for GNU Network Object Model Environment. The GNOME Project, which is part of the GNU Project, is responsible for software development via a community of volunteers and paid contributors.

Since the GNOME 2 release user productivity has been a key focus. Consequently now all GNOME programs share a coherent graphical user interface style thanks to a detailed Human interface Guidelines (HIG) document.

The GNOME HIG addresses everything from high-level GUI design to recommendations for pixel-based widget layouts and so encourages developers to create high-quality, consistent and intuitive GUI programs.

you're someone that's always hungry for the latest enhancements, you'll be

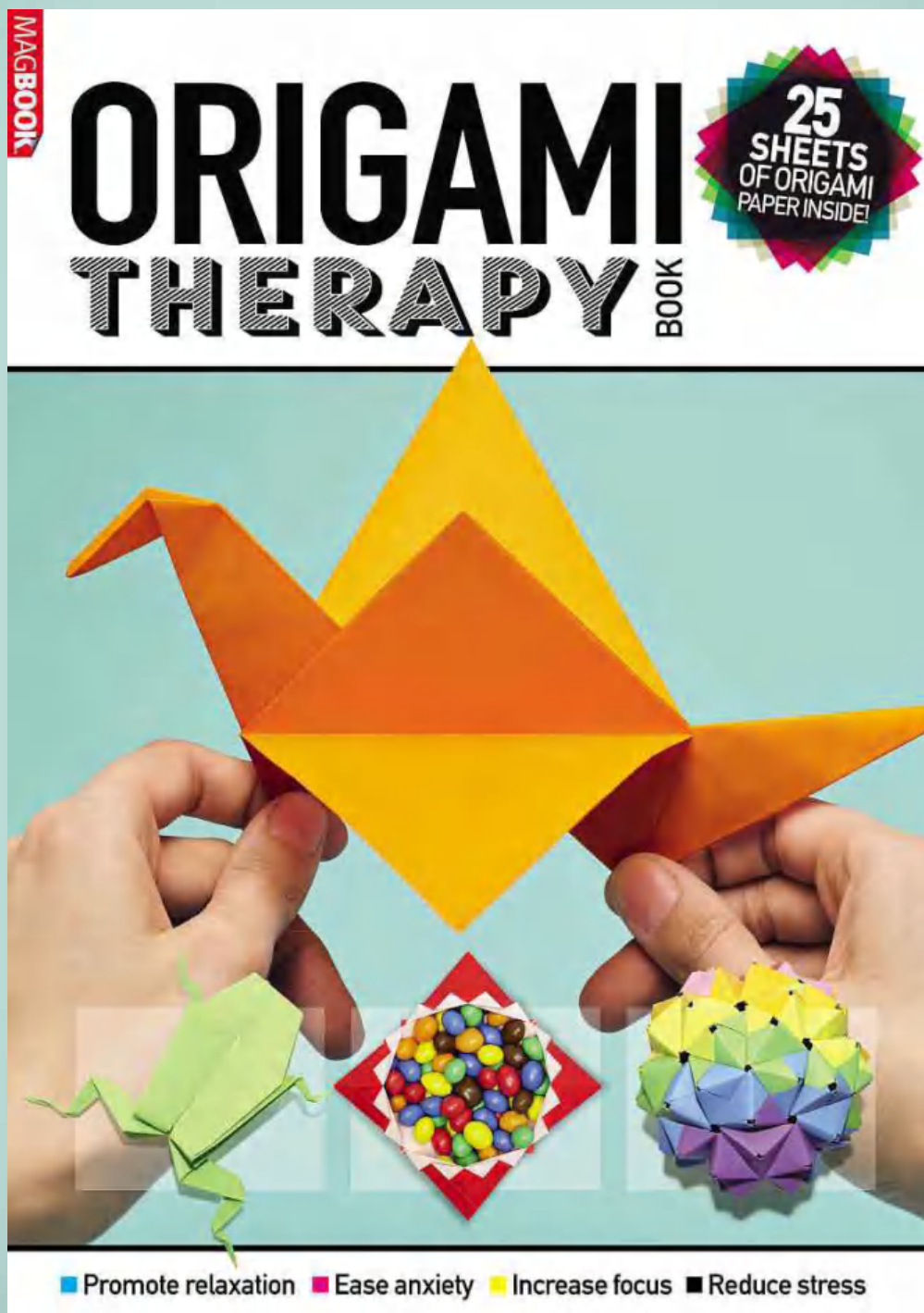
delighted to know there are two Ubuntu releases per year. In fact, the 16.10 edition is already at alpha status and is due out in October (hence the '10').

Ubuntu MATE has a lot to offer, and experimenting with a fully fledged Linux distro is both fun and educational. So if you own a Pi 2 or Pi 3, find an empty 8GB microSD card, install the image and give it a try. Then get in touch at letters@micromart.co.uk and tell us what you think. [mm](#)

“ Ubuntu MATE is often viewed in the same light as distros like PCLinuxOS, which offer a smooth transition from Windows or macOS ”

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Remembering... Turbo C++

This week we recall the early years of the modern software development

Back when we had a young brain thirsty for knowledge, and plenty of time on our hands, we took the move from BASIC to Z80 Assembly in our stride. It was fun, and we managed to get some interesting results from the old Spectrum. Time moved on, though. Soon, college beckoned, then work, and then the rest of lives. Those of us who had continued to grasp programming moved on, while those of us who didn't occasionally dipped our toes into whatever was available. It was around this time that we discovered Turbo C++.

Turbo C++ was from the American company Borland – which had previously released Turbo C a few years earlier in 1987. It was a brave new world for programmers: the familiar blue screen background of Turbo C with a plethora of additional libraries and extensions, utilising the increasing power of PCs in the DOS and Windows 3.x era.

By today's comparison, with a fully featured GUI, in-line error checking and so on, Borland's Turbo C++ looks pretty bleak. However, that didn't deter the programmer of the time – obviously due to the fact that they didn't know any better. The better structure, libraries, linkage and complex data type were a marvellous leap for the C language.

Admittedly, it wasn't the friendliest environments to march into with the aim of becoming a games developer. Gone were the days of simply learning how to move the letter 'A' across the screen in BASIC,

Turbo C++ was a far more complex beast to tame. Still, it has its foundations with many a developer and you'll probably find that most of the C language users of a certain age cut their teeth with Borland's software

History

C++ itself can be traced back to the late 70s, when Bjarne Stroustrup was working on his PhD at Cambridge with the Simula programming language. Having found that too slow for what he wanted to accomplish, he began to develop C with Classes, and its compiler, Cfront.

At the time, Borland was developing Turbo Pascal, Sidekick (an electronic organiser utility for DOS), database products and tools. In 1987 it acquired Wizard Systems, a company that was developing Cfront and C language products. Later that year Turbo C was released, and underwent several versions until version 2.0 in 1988 – when the famous blue screen was introduced.

In 1990 Borland launched Turbo C++, merging the development role of Turbo C and including the Turbo Assembler which replaced the aging Cfront compiler. Its popularity grew considerably over the next few years, with usage that dominated the market and regularly beat Microsoft's own QuickC. This was widely put down to Borland's rather 'creative' alternative take on licensing its software. The Borland No-Nonsense License Agreement allowed you to make as many copies of its programs as you like, as long as you only used one copy at once.

Did You Know?

- Version 3.0 supported C++ templates
- DOS executables for 8086 real mode and 286 protected mode could be created
- Turbo C++ was split in two different versions in 1991, with Turbo C++ for the home user and Borland C++ for the professional
- You can download a new Turbo C++ mix from CodePlex at turboc.codeplex.com

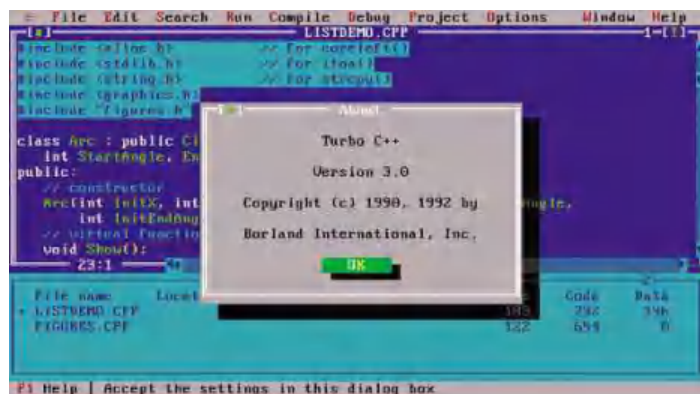
Turbo C++ had a run that lasted for many more years. Borland's role in the story effectively ended with version 4.0, released in 1993. Sadly, the update program for that stalled in 1994, apparently due to disagreements at the top of the Borland management chain. However, In 2008 Embarcadero Technologies bought all of Borland's compiler programs, and in 2009 all Turbo C++ editions were discontinued; but C++ Builder was launched on which Turbo C++ is the foundation.

The Good

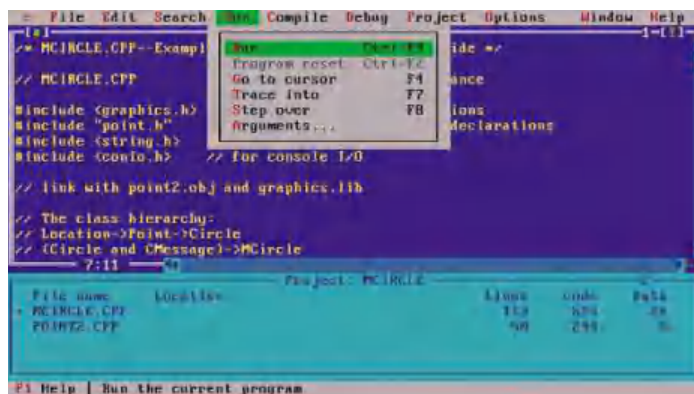
Fast environment, able to create EXE and COM files.

The Bad

Could be confusing, not a huge amount of help available for a newcomer. [mm](#)



▲ Turbo C++ 3.0 with its blue background, and DOS heritage



▲ Version 1 though was the one that most of us will remember

Component Watch

Hardcore PC gamers may scoff, but a lot of people prefer to get their mitts on a console-style controller – so here are some great deals...

Ever get irritated that controlling games on your PC just isn't as intuitive as controlling them on your games console? Fancy a controller that can satisfy your retro cravings and get you away from that keyboard/mouse combo? Well, this week's Component Watch has you covered with a games controller for every budget.

Deal 1: Thrustmaster Dual Analog 4

RRP: £15 / Deal Price: £10

So, let's start at the bottom of the price range, then. This super-cheap gamepad has everything you need for playing games on your PC: a USB connection, analogue thumbsticks and an array of buttons to put any console controller to shame. It even has rubberised grips for extra comfort. Yes, it's unashamedly basic – and probably lacks a little of durability and styling that hardcore gamers would crave – but it's priced to match its build. In fact, this is one controller where savings make it virtually impossible to ignore – it was cheap anyway, but with 30% off retail it's a steal. Frankly, we can't imagine a better deal.

Where to get it: Overclockers UK (bit.ly/2b6gMv2)



Deal 2: Xbox 360 Wireless Controller

RRP: £40 / Deal Price: £30

While people would argue long and hard about whether the Xbox 360 was the king of games consoles in its time, there aren't many that would put up a fight if you noted it's controller set the standard for that generation of gaming. The 360 is now pretty long-in-the-tooth, eclipsed by the Xbox One and winding down in terms of interest, but that makes it a great time to buy one of its Windows-Compatible controllers. With unparalleled design, it's an essential gaming accessory – vibration, wireless, analogue inputs, even Xbox Live integration from the unit itself. There's nothing you could ask from a basic controller that this one doesn't do to perfection.

Where to get it: Currys (bit.ly/2bg7kWG)



Deal 3: Mad Catz C.T.R.L.R

RRP: £40 / Deal Price: £36

This full-size universal Bluetooth controller from Mad Catz is compatible with iOS and Android devices as well as PCs, Macs, and devices like the Fire TV. It even has a mouse mode and media controls so that it can be used to control Bluetooth devices that might not ordinarily support a controller. On the PC it's fully customisable and it charges simply over USB. If you're after a game controller that can work with everything you own, this might be it.

Where to get it: Stuff-UK (bit.ly/2aLGgQi)



Deal 4: Steelseries Stratus V2

RRP: £60 / Deal Price: £55

This Bluetooth controller is designed for use with iOS devices (7, or higher), including the Apple TV. It supports hundreds of games and features pressure-sensitive buttons and d-pad, dual analogue sticks and 10 hours of battery life. It even has on-device multiplayer and a menu key so you don't even have to touch the remote. It charges over USB, but all you need is included.

Where to get it: Overclockers (bit.ly/2b3oG5j)



Deal 5: Xbox One Elite Wireless Controller

RRP: £130 / Deal Price: £109

Designed in the style of the Xbox One controller, this 'Elite' model has better speed and accuracy, with interchangeable metal thumbsticks, D-pads, and paddles so that you can enjoy the optimum experience for your style and preference. It's undoubtedly aimed at high-end gamers only, and a price like this means you'll have to REALLY want one – but you can still save a fair chunk on it this way.

Where to get it: CCL (bit.ly/2aLo725)





Android Devices At Risk

Serious security flaw discovered by researchers

Ransomware Tops Cyber Attacks List

18 million new samples in one quarter

PandaLabs has released its latest quarterly report on all things malware, and it's ransomware that takes home the trophy for the cyberattack we most need to be aware of.

The anti-malware lab of Panda Security reviewed the 18 million new malware samples that were discovered in the second quarter of the year, which works out as an average of 200,000 samples every day. Yikes. The most-used tactic for cybercriminals is indeed ransomware, money naturally being rather important to the bods carrying out this kind of thing – much to the cost of the poor victims, of course.

If you'd like an example of how bad this kind of thing can get, contact information for 1,100,000 users was stolen from an online dating website, leaving affected users' details exposed. How to recover that information? Pay up, of course. Point of sale terminal malware is also on the rise. PandaLabs discovered malware had affected over 200 restaurants in the United States and stole information from credit cards used in those restaurants.

The report also states that Android is a "dangerous ecosystem", because attacks are increasing "exponentially". Malware: don't you just loathe it?

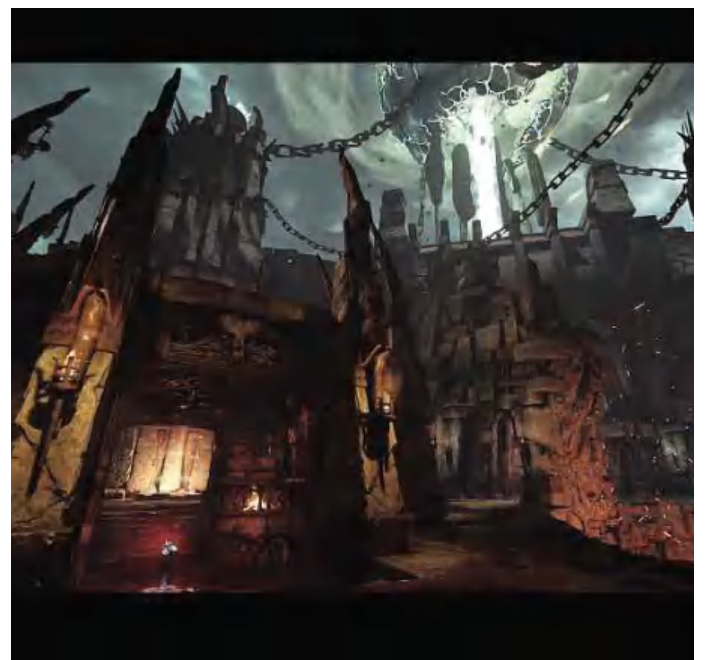


DOOM DLC Pack For Download

Go Evil for £12

DOOM's first premium DLC pack, *Unto the Evil*, is now available for download on PS4, Xbox One and PC.

Costing £11.99, this is the first of three packs that will bring all-new multiplayer content to the award-winning first-person shooter. *Unto the Evil* provides three new maps to dominate, one new playable demon to unleash, a new weapon to master, a new equipment item and a host of new armour sets, taunts and hack modules. Lovely.



Check Point researchers have found some serious security bugs in software found on hundreds of millions of Android devices, meaning consumers around the globe could be at risk.

The researchers, who presented their evidence at the DEF CON 4 event in Las Vegas, looked at software running on chipsets made by Qualcomm. You'll find Qualcomm chips in around 900 million Android

smartphones and tablets, so this is clearly a potential headache for many of us. The bugs themselves are labelled QuadRooter and are a set of four vulnerabilities, any one of which could be exploited, with an attacker potentially triggering privilege escalations to attempt to gain access to a device.

Thus far, fortunately, there is no evidence that cybercriminals are using these security flaws in any attacks, but that's not to say that they won't in the

future. Indeed, a Check Point bod is reported in the press as having said, "I'm pretty sure you will see these vulnerabilities being used in the next three to four months."

With affected devices including handsets from HTC, BlackBerry, Google Nexus, LG, Samsung (including the Galaxy S7 and S7 Edge and Sony's Xperia Z Ultra), you can see the full list of affected phones for yourself over at the Check Point blog (blog.checkpoint.com).



Should robots be able to kill humans? This question is at the heart of this week's look at robotics and AI in warfare and even in automotive technology. Right now, of course, robots, drones and so on can be used to cause destruction, but only with direct control from humans. Essentially, they're just tools, like knives or guns.

What's worrying is that at some point military organisations might feel it's justified to allow AI-controlled robots to act autonomously on the battlefield, ending lives based on software algorithms.

It's a scary thought. The programming would still be created by humans, of course, and with strict limitations, so there's no *Terminator*-like future awaiting us. But software, being created by imperfect humans, is itself flawed. It can be hacked, for a start, which would put killer robots in the hands of our enemies. And it can also be poorly coded, which can lead to unpredictable results. That could lead to a scenario where humans are killed because of a syntax error or some other bug.

I'd like to believe that our governments are going to approach this subject sensibly, but as we've seen in the past, some countries will take any military advantage they can.

Anthony

Elder Scrolls: Legends Now In Beta

Free-to-play for PC users

Bethesda Softworks has announced the launch of the PC open beta for the *Elder Scrolls: Legends*, its first free-to-play card game based on the award-winning *Elder Scrolls* series.

The game promises innovative and strategic two lane gameplay, an "epic" single player campaign and several multiplayer modes versus AI or live opponents. This is billed as having accessible

gameplay for beginners who want to get started quickly, while also providing strategic depth to keep more expert players engaged.

If you're interested in a fresh take on trading card games, download this open beta now for free via legends.bethesda.net. You can expect to see a full release on this later in the year, where it will launch on PC, Mac and both iOS and Android tablets and mobiles.



Meanwhile... On The Internet...

Google has, for some time now, had it in for Adobe's Flash. Picking up the mission Steve Jobs started all those years ago, when Apple dropped flash for iOS ([tinyurl.com/MMnet27a](#)), and following the temporary block that it and Mozilla placed on the plug-in last summer ([tinyurl.com/MMnet27b](#)) it has now euphemistically announced that it will seek to 'de-emphasize' its use in favour of HTML5.

We're told the first step to obliterating the oft-exploited platform for running video, animation and games within webpages will come with Chrome 53 in September. That will stop any background processes using the plug in (which Google reckons is about 90% of Flash usage these days). After that, by the time we come to December and Chrome 55, HTML5 will be the "default experience", and you will have to explicitly tell Chrome to run Flash stuff if there is no alternative ([tinyurl.com/MMnet27c](#)).

This, as *The Register* puts it ([tinyurl.com/MMnet27d](#)), effectively puts Flash "out into the cold winter's night", because web developers will be loathed to use a protocol that they know will frustrate visitors to their services. Of course, some will be put in a difficult spot for a while by Google's decision – which, while not a nuclear option, certainly appears to be a bell toll for one of the web's longest running love/hate relationships. It only takes a brief trawl through the comments section of the Google Chrome blog to see that, while most people applaud the shift, not everyone's happy.

Still, people have been predicting the death of Flash for a good while now... But we're still installing the updates, aren't we? Time will tell if this will finally prompt Adobe to give up the ghost on its leakiest of offerings ([tinyurl.com/MMnet27e](#))? Well, it's already doing that, kinda, with changes in the Flash Professional software, which is now called Animate CC ([tinyurl.com/MMnet27f](#)).

We've recently covered a few stories about Facebook's Newsfeed and accusations of bias. However, as we're already on the subject of Google, let's talk a little about a recent story regarding Google Maps has led us to consider the subject from a different angle.

A recent condemnation of the company came from a group called the Palestinian Media Forum, it's press release keen to call out the company for allegedly 'deleting' Palestine from Google Maps ([tinyurl.com/MMnet27g](#)). When the story was picked up on social media, and the hashtag **#PalestineIsHere** started trending across Twitter, it prompted many people to sign up to a Change.org

petition calling for the reinstatement of the disputed territory (recognised by the UN and 128 other countries but not by the US or Israel). We wonder how many of them noticed that the petition was actually five months old?

The real story here, we guess, is that what started as a classic online firestorm and grist to the conspiracy theory mill was, as it turns out, not everything it seemed. The truth was actually stranger, and just as unsettling, as the meme.

The thing is this: according to Google, Palestine has *never* appeared as a country in its own right on its mapping service, though since 2013, in a widely reported shift, it has referred to the area as Palestine, rather than the Palestinian Territories in line with the UN ([tinyurl.com/MMnet27h](#)). The only change that has happened regarding that area of its maps recently, we're told is that a bug caused the labels for 'West Bank' and 'Gaza Strip' to disappear ([tinyurl.com/MMnet27i](#)).

It highlights, once again, just how much influence companies like Google can have on how we see the world ([tinyurl.com/MMnet27j](#)) – not just in major ways, like whether a country is genuine or not, but in a million small ways too – as a quite brilliant, in-depth comparison by former lead Apple cartographer Justin O'Beirne points out ([tinyurl.com/MMnet27k](#)). As the *Washington Post* writer Caitlin Dewey put it ([tinyurl.com/MMnet27l](#)): "even Google and Apple, which appear so removed and authoritative, bring their own interpretations to these important questions."

Indeed they do, Bing's mapping labels Palestine as it's own territory, while Apple's does not demark it from the larger Israeli state. It's all a matter of interpretation it would seem. Though, perhaps more interesting is the way such global companies shift their interpretations to suit different audiences and expectations around the world ([tinyurl.com/MMnet27m](#)). Palestine isn't the first or last time something like this will come to light, the problem may come when, in a changing digital world, there aren't two physical maps to compare and contrast – and it becomes increasingly difficult to keep track exactly when policy changed and the political winds shifted.

We've often enjoyed the uplifting stats of Max Roser (@MaxCRoser) and the [ourworldindata.org](#) to which he contributes, for the wider view they take of a world we often consider to be going to the dogs. Apparently, we're not alone in our appreciation ([tinyurl.com/MMnet27n](#)).

.AVWhy..?

In the year when one of our favourite shows, *Mythbusters*, shut up shop, this video from former plumber, turned TV presenter and YouTuber, Colin Furze reminded us of one of our favourite segments from the show. The video, which shows Furze testing out his terrifying, 9m high, 360° swing ([tinyurl.com/MMnet27p](#)), reminded us of the time the Mythbusters team investigated the physics of swinging over the bar on a child's swing ([tinyurl.com/MMnet27o](#))... A stunt that anyone who was a child in the 90s knows was a big mistake ([tinyurl.com/MMnet27p](#)).



Caption Competition

"Which game developer do I work for? Bungee, of course."

Two weeks ago, we left you with upside down image, and asked you for captions. Here's a selection of the best:

- **JayCeeDee:** "I told the hairdresser I wanted dreadlocks, but she gave me leadlocks."
- **Darren Green:** "Not the recommended way to hang up your phone."
- **doctoryorkie:** "Not quite what Blondie had in mind."
- **JayCeeDee:** "The Doctor said the blood wasn't getting to my brain, so I thought I'd help it!"
- **Thomas Turnbull:** "I wish I'd never bought this Batphone; it only works when I'm upside down."
- **John Malcolm:** "You see, I SAID I'd do anything to appear in a *Micro Mart* Caption Competition!"
- **John Malcolm:** "Are you sure I get better reception like this?"
- **Sean McDougall:** "Yes, he got the bungee jump length just right."
- **Leigh Spriggs:** "Sally took drastic steps when her broom broke."
- **Julie Martin:** "Nope, no Pokémon on the ceiling either."
- **Robert Wheelhouse:** "Don't you just hate it when your phone hangs?"

The winner, though, was Cameron Grainger with "Which game developer do I work for? Bungee of course."

If you have a caption for picture below, head to the 'Other Stuff' section of our forum (forum.micromart.co.uk), or email us via editorial@micromart.co.uk, remembering to add the issue number to the email subject line.



Apple Allowed To Sell Solar Energy

Rich company gets richer

Apple has been given permission to sell energy that's generated at a solar farm in California.

Apple bought the solar farm last year, and it's now been told by federal regulators in the US that it can sell energy that's generated to wholesale markets.

The company has said that the energy generated at the site could power 60,000 California homes. so it's sitting on a significant energy generator.

The idea of Apple moving into new revenue-making fields isn't outlandish, and the company is unlikely to cause any significant ripples in the energy market.

Facebook Says No To Clickbait

The solution will shock you...

Nobody likes clickbait, and now Facebook has put its foot down by stepping up its efforts to stop clickbait news on its service.

Facebook has stated that it can automatically stop these stories from appearing on the social network by building technology that scans for clickbait via its news feed, based on a review of thousands of headlines to put together a list of commonly identifiable traits. Once these kinds of stories are found, Facebook can stop them from appearing in your feed.

Facebook posted, "With this update, people will see fewer clickbait stories and more of the

stories they want to see higher up in their feeds." The blog post also gave an example of the worst kind of these stories, an example we just had to share: "He Put Garlic In His Shoes Before Going To Bed And What Happens Next Is Hard To Believe."

Love it.



Snippets!

Yahoo Messenger Shut Down

Well, we were warned. Yahoo has indeed switched off older versions of Yahoo Messenger, just as it said it would.

With a more modern version released last year, Yahoo has rather sensibly decided to put the older versions to rest. There are some people who aren't too happy, though. According to reports, oil traders and analysts are apparently very keen on Yahoo Messenger as a means of chatting over commodity prices.

You learn something new...

More Malware News

Both Symantec and Kaspersky Labs have reported on some mighty malware, possibly designed by a state-sponsored group, that has gone undetected for years.

Dubbed Project Sauron by Kaspersky, the firm claims to have seen it in over 30 organisations globally, and with Symantec also separately reporting on the malware, which is said to have targeted high-level targets, consider this a serious threat.

White Xbox One Sells Out... For Good

Microsoft's white Xbox One S 2TB has reportedly sold out and, according to online reports, Microsoft will not be making any more of them.

The model was always meant to have a limited run, but this one really did sell very quickly indeed. Expect some of these to remain on the web at inflated prices, so we hope nobody is sucked in on that score.

This does rather prove that consumers are happy to go crazy on the latest console releases. We'll wait for the Nintendo Classic Mini, thanks.

Intel Issues Full Recall Of Basis Peak

Fitness tracker causes users to 'feel the burn' a little too much

If you own a Basis Peak wearable fitness tracker, stop wearing it right now. Intel-owned Basis has issued a full recall of the device because of reports of overheating, with the fault actually causing some burns and blistering for a small percentage of users. The overheating issue is apparently due to an active LED on the back of the wearable that monitors the user's heart rate.

Having tried to fix the problem via a software update, Intel realised that that wasn't go to work, so it issued this recall. The recall notice reads, "We are recalling the Basis Peak watch because the watch can overheat, which could result in burns or blisters on the skin surface. It is important that

you stop using your watch and return it. You will receive a full refund."

The Basis shop was also down at the time of writing, and the blog post does rather suggest that time is up altogether for the device.



Iran Bans Pokémon Go

First country to ban global phenomenon

With concerns over the app's use of location-based technology, Iran has banned Pokémon Go.

The Guardian quoted an Iranian official as saying that the ban has come about because the game hasn't obtained permission from the ministry of culture and Islamic guidance.

Security surrounding the game is the problem here, and while these are hardly the first words of warning about the game, this is the first time an entire country will not be able to play the wildly popular mobile experience.



Apple Launches Bug Bounty Program Big money rewards

Apple's bug bounty program now offers the highest rewards in the industry, with possible payouts as high as \$200,000.

The program was highlighted at the Black Hat security event, and the company's head of security engineering and architecture said that Apple will now pay for insecurity discoveries.

Payouts include up to \$100,000 for extraction of confidential material protected by the Secure Enclave Processor, up to \$50,000 for executions of arbitrary code with kernel privileges, and up to \$25,000 for access from a sandboxed process to user data outside that sandbox.

One point of note: this is only available to an invited set of researchers.

Samsung Gains Ground On Old Rival Apple looking over its shoulder

Apple and Samsung have been locked in battle for many years now, and it would seem that Samsung is doing something right, because data from a phone retailer suggests the company has clawed back some market share.

Mobile Phone Direct is responsible for the data, and it says that over the past year, Samsung outsold Apple in the latter half. Sales of the Samsung S6 Edge and S7 Edge beat sales of the standard S6 and S7, and Apple's own market share went from 54% to 41%.

Drone Crime On The Up Great – another thing to worry about

The Independent newspaper has submitted Freedom of Information requests to police forces on drone crime, and it has reported that crime involving drones increased significantly last year.

The newspaper wrote that the number of incidents reported to the police involving drones rose by 352% between 2014

and 2015, with public suspicion of drones driving that increase in reporting. Furthermore, 272 incidents were reported between January and May of this year, so drone crime reporting is very much in the public consciousness.

The story also wrote of an incident in Northern Ireland, in which a drone was used to help a criminal film a cashpoint. Outrageous.

Top Ten Pokémon Nests In UK

Gotta catch... oh, forget it

Bus search engine Check My Bus has come up with a list of the top ten Pokémon nests in the UK to give Pokémon Go players a leg-up. Here's the list, with six of them in the capital:

- Alexandra Palace
- Greenwich
- Tower of London
- Imperial War Museum

- Holland Park
- Primrose Hill
- Brue-ton Park – Solihull
- Parkwood Springs – Sheffield
- Bute Park – Cardiff
- East Park – Hull

It was pretty dismissive of the chances of finding anything of interest in Scotland or Northern Ireland, however. That can't be right, surely?

Tesla Car Drives Man To Hospital

Autopilot does its job

With more than their share of negative headlines of late, it's nice to be able to good news for self-driving cars.

Joshua Neally was driving a Tesla Model X vehicle in America when he started suffering a pulmonary embolism – a highly dangerous, potentially life-threatening blockage in the pulmonary artery, a blood vessel carrying blood from

the heart to the lungs. Most people would have called an ambulance but not Mr Neally. Instead, he used the Tesla's autopilot mode to find a hospital, something the car duly managed to do without incident, driving some 20 miles to the nearest one.

Clearly, this particular driver is grateful for self-driving technology, and with recent media reports focusing on Tesla crashes, the company will no doubt welcome some positive press coverage.

Aorus X5S v5 Camo Edition

Got a lot of money going spare? Then this is laptop for you

DETAILS

- Price: from £1850 (Review Model: £2100)
- Manufacturer: Aorus
- Website: goo.gl/6G5OrX
- Requirements: Windows login, external mouse for best gaming results

We had the pleasure of reviewing the Aorus X3 Plus a little while back and were immensely impressed with its features, performance and build quality. Now, though, we have a rather special version of the X3's big brother, the X5S. Specifically: the v5 Camo Edition.

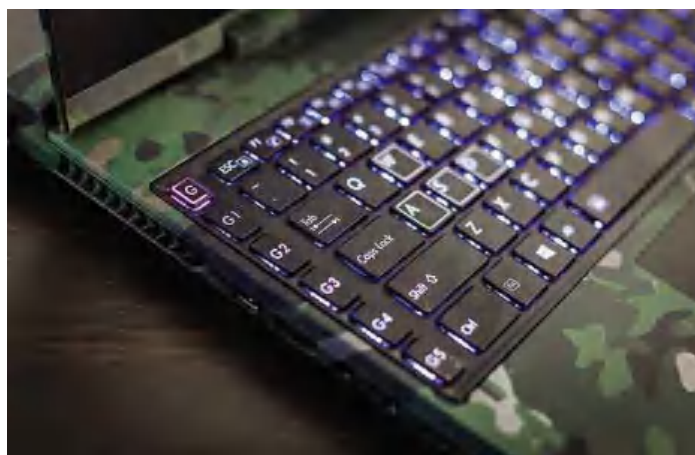
On paper, this looks to be an equally impressive high-performance gaming laptop. It utilises an Intel i7-6700HQ processor clocked at 2.6GHz and with a turbo clock speed of 3.5GHz alongside an unbelievable 32GB of DDR4 2133MHz memory and a Samsung NVMe M.2 256GB SSD. Windows 10 64-bit Home Edition comes pre-installed, while a further 1TB traditional hard drive rounds off the storage. The graphics come courtesy of an Nvidia GTX-980M, with 8GB of GDDR5 memory, a GPU clock speed of 1038MHz, turbo GPU clock of 1127MHz, 1536 CUDA Cores and a memory bandwidth of 160.4GB per second.

Connectivity is pretty amazing too, with three USB 3.0 ports, a Type-C USB 3.1 port, HDMI 2.0, Mini DisplayPort, VGA, gigabit Ethernet, SD card reader and S/PDIF out. As you would expect, there's also 802.11ac wi-fi and Bluetooth 4.1.

If that little lot wasn't already mouthwatering enough, then



▲ The Aorus X5S v5 Camo Edition laptop is extreme in every aspect



▲ It's fast, fun and expensive, and we love it

the 15.6-inch 4K, 3840 x 2160 IPS display will help spice things up. Plus, the Aorus X5S also boasts a 1.5W speaker setup with a 2W subwoofer, HD camera, as well as a backlit full-size keyboard with five gaming macros and large touchpad.

The obvious visual impact here is the limited edition camouflage print that covers the entire laptop enclosure, both inside the lid and out. The water transfer printing process is flawless and retains the laptop's metallic look and feel, even to the virtually impossible to reach places under the lid hinges. It's also scratch and fingerprint resistant, which

is certainly a benefit when you're splashing out on a unique looking laptop. Interestingly each Camo Edition laptop is different, as the paint technique creates a unique print each time – so, upon close inspection, no two Camo Edition X5S's look the same.

In terms of performance, the X5S did well. The 3DMark 11 overall score of 7346 is excellent for a laptop and only short of the official VR benchmark; indeed, we tested it with a HTC Vive and found it worked perfectly. It also ran perfectly well with 4K content from YouTube and some



selected videos. The ATTO benchmark for the M.2 SSD was equally impressive. Its 8192KB test saw a write speed of 1281MB/s, while the read speed was recorded at 2259MB/s. Similarly, the 4KB write speed was 371MB/s and the read speed 405MB/s.

Naturally this kind of performance, design and limited edition colouring doesn't come cheap. The 16GB memory model is priced at around £1,850, with this 32GB memory model pushing that to £2100. Mind you this is a truly unique system and, while most users will claim that no laptop is worth that amount of money, there are those who would find the cost justified by the laptop's individuality. Regardless of your feelings on its aesthetics, it's still a pretty amazing portable gaming and performance machine.

We really liked the Aorus X5S v5 Camo Edition. It's extreme, looks bizarrely amazing and costs an absolute fortune. If you can well and truly afford to, go get one.

mm David Hayward

A savagely expensive, but quite amazing and unique, laptop



Seraph

This angel doesn't need wings, just plenty of ammo

DETAILS

- Price: £10
- Manufacturer: Dreadbit
- Website: goo.gl/5WgyvK
- Requirements: Windows 7+, 3GHz CPU, 4GB RAM, GT-450 minimum

It's not often these days we get to sink our teeth into a fast-paced, action shooter with a decent storyline, wonderful graphics and excellent gameplay. Thankfully, though, *Seraph* –from developer Dreadbit – is on hand to help us out.

Seraph tells the tale of an angel in human form who has unwittingly released hoards of demons into the world. To regain her power, escape her corporeal state and return to her angelic form she must destroy said demons and fight her way through an increasingly difficult environment.

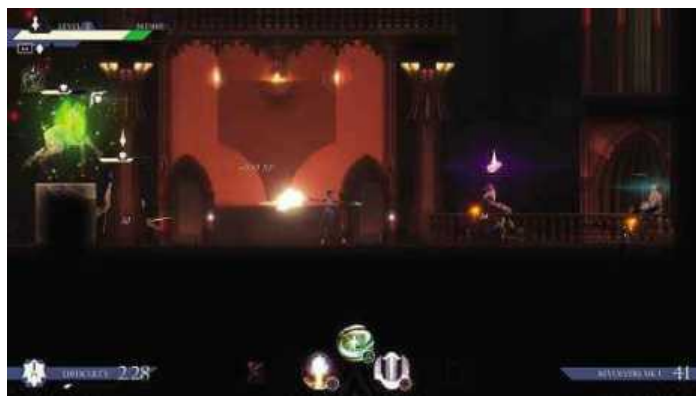
The game begins in a prison, in which *Seraph* is enslaved. Upon release, she is guided by a mysterious sentient being, who fills in the gaps in the story neatly while leading you through the first level tutorial.

Spread across the many levels of the prison, *Seraph* has you leaping from platform to platform, clinging to walls and the edges of walkways while wiping out the varied forms of demonic creatures that are in possession of your life essence. The destruction of a demon releases the life essence and other rewards, which you can then collect and build devastating combos with.

There are numerous weapons available throughout the levels. Each has a limited amount of ammunition, except for your



▲ *Seraph* looks amazing, with fluid animation and superb graphics



▲ The auto-aim feature works a treat, and some spectacular action sequences can be had

starting dual pistols. Careful use of each weapon will yield greater results, and conservation of ammo is a must if you plan on staying alive in the later levels against the bigger and more gruesome demons.

Beyond the real world guns, the *Seraph* has a set of unique abilities that can aid her in the extermination of the demon-kind. These abilities or miracles, allow you to wipe out close-quarters groups of enemies or Blink forward from one location to the next. The abilities need to be charged up, but thankfully it's not so long between charges that they're impossible to use

when your back's against the wall. Equally, the recycle time is not so quick as to make the game easy to complete.

Graphically *Seraph* is quite splendid. The main character leaps and runs through the platforms effortlessly, and with the game's auto-aiming feature, you can cut some pretty impressive Hollywood-like acrobatic visuals as you somersault through the air shooting at a brace of demons in opposite ends of the screen. The effect is executed very well indeed, and there's hardly a flaw to poke at when the action speeds up.

There is a set course, which you're guided through; arrows will point in the right direction to your destination, be that the end of level demon or the exit. However, exploration is key to finding some of the more exotic elements of the game.

In short, *Seraph* is a superb game that's entertaining, fast moving and looks great too. There's plenty to get into and extend your character progression, and it's an absolute steal at just £10. Considering it's an Early Access Steam game, *Seraph* is well designed and cleverly developed. We heartily recommend it.

mm David Hayward

A superbly designed, fast-paced, platformer



Acer Aspire R11

Mark dissects Acer's newest notebook

DETAILS

- Price: £240 (Amazon)
- Manufacturer: Acer
- Website: inyurl.com/zekgefa
- Requirements: Wired or Wireless Network
- Model: R3-131T-C7WS (NX.G0ZEK.028)

Mirroring the opening lines of *A Tale of Two Cities*, the Aspire R11 is both the best of what Acer can do and the worst. Let's start with the parts it got right, in what initially appeared to be a very serviceable notebook.

What I realised almost immediately about the R11 is that the hardware compliment bears an uncanny resemblance to the Acer Chromebook R11 I recently reviewed here in *Micro Mart*. It has the same dual-core Celeron N3060 1.60GHz processor, 4GB of DDR3L RAM and an 11.6" IPS touch panel with a resolution of 1366 x 768. I'm not sure if they share the rest of their internal components, but here the outer case is definitely thicker, reflected by the fact the overall weight has increased from 1.25kg to 1.58kg.

However, for whatever reason, Acer has given this model a slightly smaller 3270mAh battery compared with 3490mAh on the Chromebook R11. Combine that with a less power-frugal OS, in the form of Windows 10, and comparative battery life is hacked from an impressive 12 hours to just eight.

Where it also diverges from the Chromebook is in the

inclusion of a 500GB hard drive – as opposed to 32GB of eMMC storage – and a LAN port. For those who don't mind entirely dismantling a working laptop, it is possible to upgrade the storage to SSD and memory to 8GB. That's certainly a job for an expert, however, not an optimistic user with a screwdriver.

The biggest difference between this and the Chromebook R11, however, is the use of Windows 10 Home 64-bit pre-installed. It's a difference that colours everything else herein. The central concept on offer here is notebook that's effective in laptop mode but which, by employing the reversible screen hinge, can become a tablet when required. When in tablet mode, the keyboard is automatically disabled, and any

Features

- 360° hinge for use as a laptop or tablet.
- Eight-hour battery life.
- 11.6" HD touch screen (1366 x 768).
- Intel Celeron N3050 processor.
- 4GB RAM.
- 500GB hard drive.
- Windows 10.
- Webcam with mic.
- HDMI, 2 x USB 2.0, RJ-45 ports.
- Size: 29.8 x 21.1 x 2.1cm.
- Weight: 1.58kg.

textual input is then made through an onscreen interface.

So how does it do? Well, while it isn't the most powerful PC I've ever used, it can work acceptably. Unfortunately, not all the time. This isn't entirely Acer's fault but mostly Microsoft's. Where I'm used to

Windows 10 arriving smartly on desktop PC, on this hardware it drags its heels like a petulant child because of its propensity for launching things in the background and initiating huge update downloads that utterly undermine the user experience.





This is especially bad when you first use the R11 and the system is bombarded with a tsunami of updates that it consumes without any interest in what the user is attempting to do. My recommendation is to connect it to the Internet and then leave it for at least a day or maybe two. Otherwise you'll assume you've bought a complete lemon as you battle through long periods of exceptionally poor response.

Once over that hurdle – and until the next major update, you suspect – it runs much better. For office use the keyboard is surprisingly responsive, and the trackpad is big enough for gestures not to seem overly cramped or unnatural. For writing the odd email or surfing this performance level works. As a tablet PC it's less convincing.

Tablet mode can be initiated automatically by detection of

the screen angle or within Windows 10, upon which the interface takes on a more Windows 8 appearance.

Again, the major problem using this machine with Windows 10 as a tablet is the abysmal Microsoft Store and the sad collection of universal apps contained within. Put simply, in comparison to the Apple or Android ecosystems, it isn't a practical alternative unless you don't really use apps

at all... A way of working that makes tablet mode largely irrelevant. That's a real shame, because the R11 is a fine enough piece of hardware for the money and deserves to show what it can really do.

Acer isn't entirely without blame, however. As ever, it appears to have viewed this PC as a repository for a seemingly endless collection of bloatware. Along with the project fear of Anti-virus tools, McAfee, Acer's gummed the R11 up with Foxit PhantomPDF, Dashlane Password Manager, Avast SecureLine, Ebay Worldwide, Amazon 1Button and a dozen of their own apps for good measure. Layered on those are all manner of links and trials, many contributed by Microsoft. Oh, and for those wondering, if you reset the PC they come back even if you deleted them previously.

I've questioned why company's do on more powerful computers before, but here it's even more confusing. The R11 is cluttered with all manner of junk that takes away resources that it very badly needs to run well. Therefore, along with allocating a day for the system to update and stabilise, I'd allocate another day to de-gunk it for optimal performance.

In the end, it feels like destiny and its own branding have conspired against the Aspire R11. In a parallel universe, I'm recommending to you wholeheartedly right now.

mm Mark Pickavance

Uncontrollable updates and bloatware ruin a good PC



Buffalo LinkStation 520 2TB

A two-bay NAS that's easy to use and reasonably cheap? Yes please

DETAILS

- Price: £180
- Manufacturer: Buffalo
- Website: goo.gl/hM0aBt
- Requirements: Gigabit network for best results, any modern browser, SATA 3Gb/s drives for upgrading



▲ The LinkStation 520's drives are easily replaced or upgraded



▲ Although not as complex as some NAS, the LinkStation 520 is easy to use and works a treat

The Buffalo LinkStation 500-series offers both single bay and dual bay NAS solutions. We've looked at the LinkStation 510, a single bay NAS, in another review, so now it's time to check out the newest member of the 500-family, the 520.

This is a two-drive device with capacity options of 2TB, 4TB, 6TB and 8TB setups. Inside you'll find the same Realtek RTD1195N dual core 1GHz and 256MB of DDR3 memory that the single bay LinkStation 510 enjoys, but this time there are a couple of 1TB drives pre-installed inside it.

Connectivity consists of a single USB 3.0 port along with a gigabit Ethernet port, DC power in, a power slider switch and the multi-use Function button – to initiate the USB transfer between devices and initialise any custom settings you've added.

The device measures 87 x 126 x 205mm and weighs a reasonably chunky 2.5Kg. Again, as with the other 500-series we've reviewed, the matte black plastic casing is well constructed and cable of taking a few knocks. There are a couple of LEDs located at the front of the NAS for power and when a USB transfer is in operation.

The front door can be removed, popping off completely – as opposed to a

swing door option – revealing the two Western Digital Green drives inside fitted to a couple of hot-swap drive bays. Removal of the drives is as simple as pulling on the handle, and you can custom fit any SATA 3Gbps drive up to a maximum capacity of 8TB – though you should check the Buffalo website for further compatibility details.

There are a number of storage options when you first set up the LinkStation 510. The default is RAID 0, offering a capacity of around 1.8TB and better performance but no redundancy should anything go wrong. You also have RAID 1, which drops the capacity to just under 1TB, but with mirroring for data safety should one of the drives fail. Finally, there's a Linear

option, where the total capacity of all the drives is available, but without any redundancy.

Setup was easy thanks to the Buffalo NAS Navigator app and the Linux-like web portal of the drive. Once you've added a user, set up the time zone and so on, you'll be presented with a desktop where you can gain access to the LinkStation's functions and shared folders, along with the maintenance and setup options.

Performance was better than the 510, with read and write speeds around 87- and 74MB/s respectively – less than advertised, but more than enough performance for a media server or network backup device.

The available applications cover all the usual bases: DLNA, FTP, Samba, AFP and a BitTorrent Downloader. Each appears to work well but, as with the other 500-series LinkStation, there's a lack of the customisation options you get from Synology or QNAP.

The LinkStation 520 lacks flexibility but replaces it with good design, ease of use and only costing around £180. There's plenty of scope for growth, since the drives can be removed and changed for bigger capacities, and it ticks all the right boxes for the average home and office user.

mm David Hayward

Very capable, with plenty of room for expansion



Chieftec GPC-700S PSU

An above average PSU for a below average price

DETAILS

- Price: £39
- Manufacturer: Chieftec
- Website: goo.gl/ga1NyK
- Requirements: ATX case

Chieftec has been in the PSU industry for quite some time now, and it offers the system builder a range of power supply units that cover pretty much every aspect of computing. In its range, there are modular designs, eco-friends PSUs, small form factor offerings, as well as those catering for those who demand the most from their system.

The GPC-700S is a new model PSU that sits in the company's I-Arena Series, using the latest environmental technology and industry standards. It's a standard ATX model with a single +12v rail rated at 52.5A, with 22A on both the 3.3V and 5V rail using sealed cabling in a traditional, non-modular format. It's a 700W maximum load PSU measuring 140 x 150 x 87mm, with a 120mm silent fan positioned at the bottom of the chassis. It's an 80-plus PSU, although it lacks the Bronze certification.

Connectivity is good with a single 24-pin cable measuring 450mm in length, two pairs of 6+2 PCIe cables with the first set measuring 450mm from the unit and continuing for another 150mm for the second set; there are also six SATA power connectors on two 350mm length cables, with 150mm between each, and with each SATA power cable terminating in a Molex. Finally, there's a

► *The Chieftec I-Arena Series GPC-700S is surprisingly good considering the low cost*



▲ *The build quality is good too, and we're happy with the connectivity here*

4+4 EPS on a 500mm length cable with a further 150mm separating the two.

Sadly, as we said, this isn't a more modern, modular design, but for the work of a decent 80+ efficient PSU it does the job well enough. It's also worth noting that the GPC-700S complies with the European ErP (Energy related Products) Directive.

We didn't have any issues fitting it to our ATX test case. The lengthy cables are a godsend as, more often than not we end up with far too short SATA power and PCIe cables, but the Chieftec GPC-700S's 450mm from the PSU chassis were more than enough. Incidentally, the 150mm gap between the two four-pin EPS plugs is helpful too.

It's a sturdy PSU with a higher than average quality build. The fan too is good quality and barely audible above the general noise levels of the processor fan and case cooling. All-in-all we don't have any complaints about it.

The Chieftec GPC-700S is priced at £39, which makes it an affordable solution for the average system builder who's looking to put together a more cost effective PC.

mm David Hayward

A decently priced PSU with generous cable lengths



CyberGhost 6

Top class anonymity and privacy from the best VPN service around

DETAILS

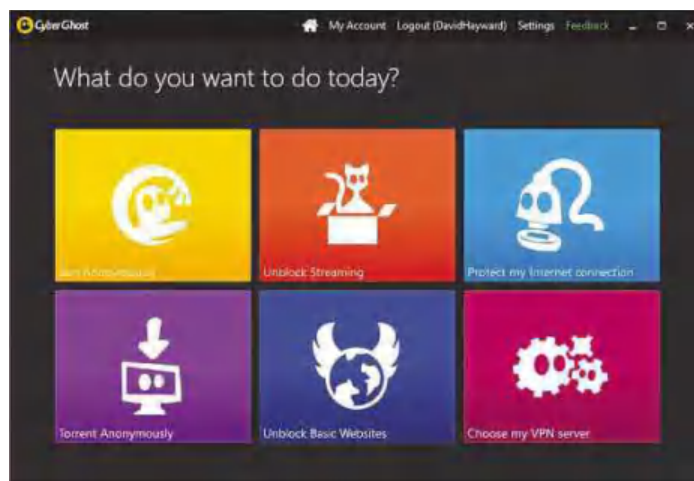
- Price: From free to £5.83 per month
- Manufacturer: CyberGhost
- Website: goo.gl/YczTil
- Requirements: client v.6 for Windows and iOS, client v.5 for Linux, OS X and Android

CyberGhost has been at the forefront of privacy for PC and mobile devices for quite some time now. The services it offers are regarded as some of the best in the VPN world, and now the company has released version six of its Windows PC-side client.

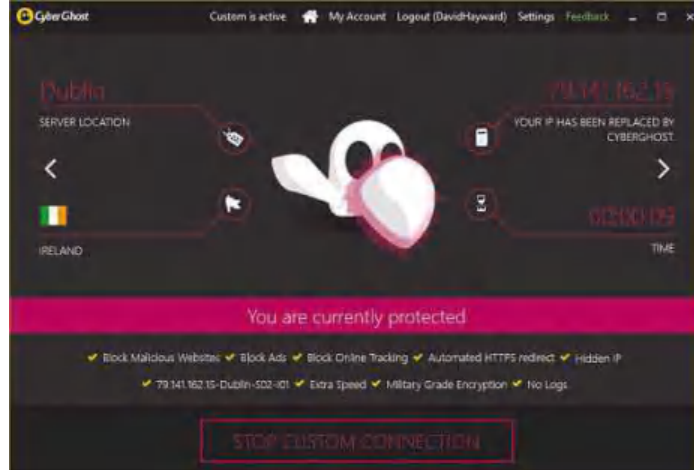
The new client's UI is radically different from what we've previously seen. Gone is the map of the world, where your current location and destination connected server were indicated by a marker, instead we now see a selection of six active tiles in a Windows 10-like theme. Mac and Linux users can still sign up and access the service, but the client will still be v.5 and maintain the old look and feel for now.

The six tiles show the different services that the company offers: Surf Anonymously, Unblock Streaming, Protect My Internet Connection, Torrent Anonymously, Unblock Basic Websites and Choose My VPN Server.

Surf Anonymously pretty much speaks for itself. It sits at the core of Cyberghost's reason for being (as a company, it promises not to retain any record of sites you visit using its service), and using it you can choose a specific country from which to mask your connection and auto-launch a chosen browser – even in privacy or incognito mode if you wish. Furthermore, you have extra features that can be activated such as blocking



▲ The new UI is neatly laid out and offers better access to the services



▲ Connection to the CyberGhost servers is easy, quick and extremely reliable

malicious websites, ad blocking, tracking blocking, auto HTTPS use, data compression and connection to faster servers – the use of each depends on the payment plan you've signed up for.

Unblocking Streaming is an interesting service that will let you choose the host country from which to unlock Netflix, the BBC, YouTube, Amazon Prime, ABC, 7TV, Canal+, Hulu and many more; you can even add your own streaming provider together with a specific country.

Protecting My Internet Connection enables the same features as the previously mentioned Surf Anonymously,

but without the country IP masking. In here you'll have a hidden IP, military grade encryption and no logging, all of which are the backbone to CyberGhost's core services.

Torrent Anonymously, allows you to hide your location, block any nasty online tracking and gives you the option to auto-launch either a browser or custom torrent program. Unblock Basic Website works in much the same way as the Unblocking Streaming service, in that it'll allow you to gain access otherwise blocked sites – should you ever find yourself in a country where the likes of Google are banned.



Finally, the Choose My VPN Server option lets you configure your default country connection, displaying a list of the available servers worldwide, the individual load on each server and whether it'll allow access to torrent sites or not. From here you can also set up your favourite servers and sort the list of available servers by fastest connection, most or fewest users or those that allow access to torrent sites.

Behind all this sits access to its 600+ servers across 30 different countries. That means the core service itself is still quick, giving us a download rate of around 6.5-7MB/s compared to the open connection (without using CyberGhost) of around 8.5MB/s.

The plans are reasonably priced too, with the basic free plan, a faster access Premium one device plan for £3.74 per month or a Premium Plus unlimited, five device plan for £5.83 per month. Each features anti-fingerprinting, AES 256-bit encryption, unlimited traffic and bandwidth.

The new CyberGhost 6 client offers an easier, friendlier, front-end to its anonymity services. There's enough here for those wanting the highest level of digital privacy, as well as those who wish to view blocked content. In short, another excellent offering.

mm David Hayward

A superb new client for preserving privacy



Asus Travelair N 1TB

Asus makes a better job of wireless storage than many others

DETAILS

- Price: £128 (Insight)
- Manufacturer: Asus
- Website: tinyurl.com/hzuxsdy
- Required Spec: Windows 7/8.x/10 or Mac OS X 10.6 or better, iOS 7+, Android 4+, Kindle Fire HD or HDX.

Compared with other 1TB external USB drives I've tested, the Asus Travelair N isn't especially small or light and costs three times what you'd expect to pay for this size of mobile hard drive. The justification for the additional expense is that this unit can operate using its internal battery and distribute the contents using its own built-in wireless access point.

I've seen similar things from other manufacturers work with varying degrees of success, most notable among these being the Seagate Wireless Plus. This design offers the ability to connect up to five devices using 801.11n wi-fi (no 'ac' sadly) and then access the contents using the Asus AiDrive app on an iPhone, iPad, Kindle Fire or an Android device.

It can also function as a USB external drive using a USB 3.0 port, that means that media is

▲ Wireless connection is the Travelair's main selling point

probably going to be uploaded. However, as an alternative, the unit also has an SD card slot allowing you to dump images or video captured with a camera onto the Travelair.

While I liked this feature, I didn't care for the rubber inserts that covered this slot and the USB blade port as they seemed destined to break sooner or later. They're included because Asus wanted IP43 water resistant rating, even if it won't hold up once they're detached.

For full battery longevity, the Travelair needs a full eight hours charging for its first use, the same length of usage time that you're promised from the 3300 mAh capacity battery. After this it should take four hours to get a full charge using the included charger, which is still far too long for this reviewer. You can use a PC to power the Travelair while it communicates via wi-fi, but you can't then simultaneously access it over USB, in case you wondered.

What Asus got right with the Travelair is how simple it is to connect it to a phone or tablet. Where others require you to find the access point and then login, if your device has NFC you can just place it over the Asus logo and the whole connection exercise is automated.

Initially, there isn't an admin password but, once you're connected, the AiDrive app can be used to create one and also a guest account for your friends.

The app also allows you to choose what music, videos or photos you'd like to use from the drive, your phone/tablet or an SD card if inserted.

It's all pretty painless and better than I've seen on other brands' products. You can even tell the system what the login and password is for an internet connected wi-fi nearby, so you don't get disconnected from the Internet while using the Travelair.

Rubbery slot inserts aside, the only real issue with this unit is the cost and the capacity. Seagate's Wireless Plus 2TB is just another £30 and its 1TB version is a tenner cheaper.

I think that Asus did a better job of the same concept, but it is for you to decide if it is worth the extra. You could just repurpose a laptop to do much the same job.

mm Mark Pickavance

Hard drive storage and wi-fi access in one chunky package



▲ Rubber inserts are annoying, but provide IP43 water resistance



GROUP TEST

SSD's

SSDs have fast become the norm for PCs, offering the kind of performance that traditional hard drives could never hope to compete with.

We have six prime examples on test from 250GB all the way up to 1TB, to see which are worth spending your money on.

SSD's

Corsair Force Series GS 480GB

DETAILS

- Price: £275
- Manufacturer: Corsair
- Website: goo.gl/bky8ht
- Requirements: SATA-3 for best results

Corsair had great success with its GT line a while back, with many gaming and performance systems being built around these fast SSDs. While good, they were expensive at the time, for the capacities offered, so Corsair released the affordable GS-range – slower but more accessible to the masses.

The Corsair Force Series GS has a Sandforce SF-2200 controller built around a Toshiba Toggle NAND flash memory. It comes in a range of capacities: 128GB, 180GB, 240GB, 360GB and, of course, 480GB.

The performance differs through the range of capacities, but the 480GB version is said, at least on paper, to be the best of the bunch.

This is a 7mm thick drive, conforming to the 2.5" form factor and weighing 80 grams. It's SATA-3 6Gbps and is finished in a glorious red case with black label adorned with the Corsair Force logo, which we're sure will look suitably impressive when fitted inside an equally flashy system.

Flashy designs are one thing; how it actually performs is something else altogether. Our ATTO benchmark tests returned a read value of 557MB/s in the 8192KB sequential tests, with a write value of 532MB/s. The



▲ The bright red casing of the Corsair Force GS stands out

“ At around £275, this is by far the most expensive drive on test ”

lower 4KB tests saw a read value of 178MB/s and write value of 269MB/s, which did drop slightly after subsequent tests, probably due to the limitations of the Sandforce controller and its Achilles heel when it comes to smaller file sizes.

Either way, our scores fell just short of the advertised speeds as put out by Corsair, so are more than enough for the hardened gamer or video editor to work on without fall fouling of the slow speeds offered through a more traditional hard drive.

Power consumption on the Corsair Force GS was quite high, considering the technology in use. The idle power use was down to 0.6W, but that soon went up to 4.7W when in full use – when we were conducting the benchmarks. For desktop users this isn't too much of a problem, but for laptop users,

it could make quite a difference in battery life.

Despite this being a fast and alluring SSD, many users will be put off by the cost of the drive. At around £275, this is by far the most expensive drive on test, and it's not all that much speedier than an SSD that costs a quarter of the price. It's good enough for the job at hand, and it will deliver significant performance when you need it, but there are far cheaper solutions around.



Kingston KC400 SSD

DETAILS

- Price: £95
- Manufacturer: Kingston
- Website: goo.gl/TlitgD
- Requirements: SATA-3 for best results

The recently released Kingston SSDNow for Business range consists of three main drives: the V300, KC380 and the review model we have for this group, the KC400.

The KC400 and indeed the SSDNow for Business line is designed for enterprise client workloads, delivering constant performance and a higher degree of stability for use in mission critical systems.

It comes in a range of capacities, from 128GB through to 1TB (the model we have for review is 256GB) and features technology such as end-to-end data path protection, SmartECC, SmartRefresh and a new Phison PS3110-S10 controller.

The controller is quite the talking point here, with a quad-core processor dedicated to the management of the flash

memory, an 256-bit AES encryption engine and eight channels to the flash NAND. Its list of features goes on, with a power fail circuit that'll push data from the memory to the NAND in the event of a loss of power, and the ability to recognise when a power failure is imminent so it can safely prepare the SSD. It's exceedingly

clever stuff that Kingston has implemented here.

The review pack we received was the SSD upgrade kit, so it came with a 2.5" USB enclosure, 3.5" mounting plate, SATA power and data cables and a code for downloading the latest version of Acronis True Image HD. Basically, there's everything you'll need to get the SSD fitted

and running as your main system drive or as part of a collection of drives, in next to no time.

The benchmarks were certainly good, as expected given the advanced controller and type of flash NAND used. Our ATTO 8192KB benchmark saw a read speed of 563MB/s and a write speed of 547MB/s. Likewise, the smaller 4KB test had a read speed of 365MB/s, while the write speed was 303MB/s. This was generally better than the Corsair Force GS at the larger file transfers, but beating it hands down for the smaller files.

The obvious benefits for business and enterprise systems lie with the advanced controller and its features, but running the KC400 on a home built PC will greatly improve your system's performance – plus you'll get all the extra business benefits too. It's probably overkill for a home system, admittedly, but for these read and write speeds it's something we're happy to use.

Prices of the KC400 range start at £62 for the 128GB model, up to £290 for the 1TB model. The 256GB version we had for testing is priced at a reasonable £95, which isn't too bad for this level of performance as well as the extra features.

The Kingston KC400 is a great SSD, and from a business point of view, it's probably one of the best buying decisions you could make.



▲ The Kingston KC400 is a good performer



▲ It's well priced for the level of features offered



SSD's

Transcend 1TB SSD370s

DETAILS

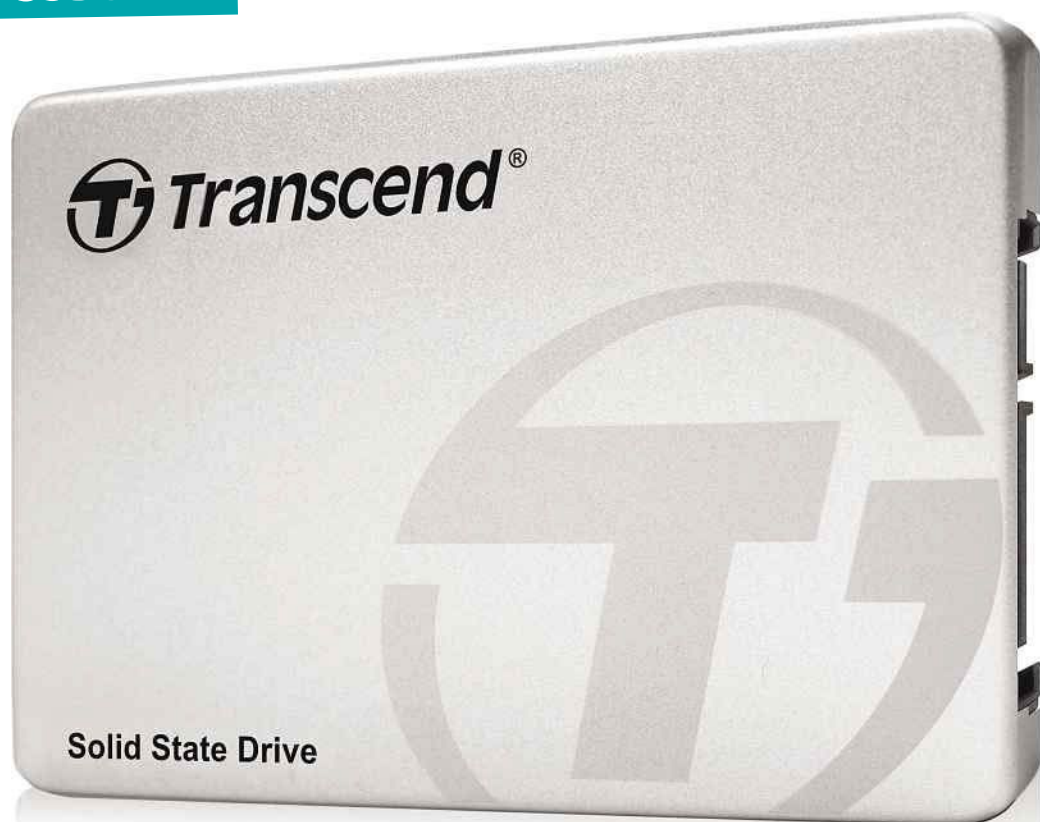
- Price: £270
- Manufacturer: Transcend
- Website: goo.gl/vz9Tvt
- Requirements: SATA-3 for best results

Transcend released its 370 range of SSDs last year to much acclaim. These drives came in a variety of sizes, from 32GB through to an impressive 1TB of storage.

The SSD370s measures 100 x 69.8 x 6.8mm and weighs just 58g. Fitting into a standard desktop case is helped by the addition of a 3.5" bracket that's included in the box, along with a quick start guide and warranty card.

The drive itself moves away from the usual Transcend SSD colour scheme of all black with red and white labelling and instead has a tasty steel effect to the plastic casing. The 3.5" bracket, though, remains a solid black from the previous SSD370, with the Transcend logo printed to one side.

➤ *It's quite expensive and not the fastest drive available*



▲ *With 1TB of storage, the Transcend SSD370s is an interesting drive*

In terms of technology features offered, Transcend has greatly improved the reliability of its SSDs by including an advanced wear-levelling system and error correction code. This improves the lifespan of the drive and helps reduce any errors that may occur when

transferring data. This feature also works hand in hand with the accompanying Transcend software, SSD Scope.

The software also offers an interface to help transfer the existing system and data to the new drive, check the health of the installed SSD, update the firmware, enable TRIM support, securely erase the drive and provide numerous details and specification to help you get the most from the newly fitted SSD.

With AATO Disk Benchmark in place, we measured a decent read speed of 560MB/s on the 8192KB file size, but with a lacklustre 325MB/s write speed. The smaller 4KB tests were slightly better, though, with 296MB/s read and 277MB/s write.

Of course the main draw is the large amount of storage on offer. 1TB is a good amount for a single drive solution – ideal for laptops or small media centre-type setups where

internal space is at a premium, while you still want as fast transfer speeds as possible without having to rely solely on external or network storage.

The Transcend SSD370s is a reasonably good drive. It's fairly quick, although the write speed was disappointing in this instance, and there's a good level of software support too. It is, though, quite expensive, at around £270. Still, that's slightly cheaper than the Corsair Force, and it's over twice the capacity.



Adata Premier SP610 512GB SSD

DETAILS

- Price: £150
- Manufacturer: Adata
- Website: goo.gl/mrckyy
- Requirements: SATA-3 for best results



▲ The Adata Premier SP610 takes its data correction seriously

A data has excelled at delivering high-quality products at reasonable prices. The company's expertise in the server and enterprise markets has been adapted to the desktop, so we can now enjoy those benefits at home.

One such example is the Premier SP610 SSD, a drive with capacities of 128GB, 256GB, 512GB and 1TB. It has

a synchronous MLC Micron 128Gbit 20nm NAND flash with a Silicon Motion SM2246EM controller, which itself incorporates a single-core

32-bit ARC (Argonaut RISC Core) processor. This means the I/O requests are handled with extreme efficiency through the use of extra instructions, which in theory should lead to a better overall performing SSD.

The SP610 does, though, offer a more advanced form of data protection than most other SSDs, with a technology called Advanced BCH ECC. This is basically a hardware error correction code that supports up to 66-bit/1KB from the NAND flash to the controller. The result is an enhancement of the overall performance and far better reliability.

The reliability is an important factor, as it greatly improves the confidence you have when RAIDing a number of SP610s. True enough, you could RAID any number of other SSDs, but the extra error correction and improved reliability here offers more peace of mind you wouldn't normally have in an SSD RAID setup.

Additionally, the Silicon Motion controller offers an improved low power consumption over other controllers, such as the Sandforce and Marvell

versions. And to complete the package, Adata has included a 7mm to 9.5mm laptop spacer and a copy of Acronis True Image HD 2013.

In our tests, the Adata Premier SP610 performed reasonably with an ATTO read speed of 560MB/s on the 8192KB file size test and a write speed of 446MB/s. The 4KB tests saw a read speed of 304MB/s and a write speed of 282MB/s.

The read and write speeds across the two file size tests aren't too far off the results from the Transcend SSD370, with the Adata SP610 being faster overall in the smaller file tests and writing in the larger test. However, it's not as fast as what the Kingston drive delivered.

The data protection and reliability side of things is a great bonus for this SSD. While it's not the fastest drive we've had on test, it's probably one that SSD RAID system builders should consider. Speed and performance are all well and good, but not at the risk of potential loss of data.

The Adata Premier SP610 512GB SSD is an okay SSD, with a larger than average capacity and decent speeds. It's also reasonably priced at around £150.

“ The data protection and reliability is a great bonus for this SSD ”



▲ It's reasonably priced for what it offers



SSD's

Intel 730 240GB

DETAILS

- Price: £200
- Manufacturer: Intel
- Website: goo.gl/AKdKGd
- Requirements: SATA-3 for best results

The Intel 730 series of SSDs at first appear to be aimed at the more professional, business orientated consumer as opposed to the average home desktop user. But there's a lot going on in the 730 that can greatly benefit the home user, provided they're willing to pay for it.

The Intel 730 series SSDs are available two capacities: a 240GB version, which is what we're testing here, and a 480GB version. Both are fairly equal in terms of the technology used, although the on-paper specifications of the 480GB version appear to have a far better write speed than the 240GB version.



▲ The Intel 730 SSD with its Skulltrail logo

The 730 series combines a 20nm NAND flash multi-level cell with a five-year warranty, and it was once a part of the more enterprise class flash drives in previous generations. The drive itself is 7mm thick and fits the 2.5" form factor neatly. It weighs around 80 grams and is designed in a polished aluminium effect case with the Intel logo in one corner and a large robot or

Terminator-like skull etched into the remaining three quarters of the drive. The skull represents the Intel Skulltrail platform that was released in 2008, based on the 5400 Seaburg chipset. It's a gaming platform but borrows a lot of work previously done in the business, enterprise arena.

Although there's plenty of performance here, the emphasis is on the longevity of the drive. The five-year warranty speaks for itself, but Intel also offers up to 70GB of writes per day endurance levels. This totals, over the length of the warranty, 127TB of write data, which you have to admit is a fairly big number.

In our ATTO tests, the Intel 730 240GB put in an 8192KB sequential read speed of just over 559MB/s and a write speed of 290MB/s. The smaller 4KB results, however, weren't quite as good as the rest of the group so far, with a read speed of around 93MB/s and a write speed of just over 180MB/s.

While the read speed at the 8192KB test was in line with the rest of the group, the poor write speed at that file size is disappointing. The smaller file

size transfers were extremely poor, however, considering the technology the drive features.

Aside from the performance, the 730 series offers other such enticements as a maximum power use when active of 5.5W and 1.3W when idle, full 256-AES encryption support and a two million hour MTBF rating.

Although on paper, the Intel 730 appears to be a great drive, the real-world tests proved otherwise. It's still good compared to a traditional drive, but when placed toe to toe with other SSDs, it simply can't compete. And at around £200, it's a little too expensive to recommend.



Samsung 750 EVO 250GB

DETAILS

- Price: £70
- Manufacturer: Samsung
- Website: goo.gl/7rcDzK
- Requirements: SATA-3 for best results

Samsung's relatively new 750 EVO appeared toward the beginning of the year in the West, after having an extremely successful tour of duty over in Asia.

Currently available in two capacities, 120GB and 250GB (although a 500GB version is set for release soon), the 750 EVO is a new generation of SSD from the company, taking the better elements of the previously successful 850 range and incorporating them into this newer model.

The 750 EVO features a new and modified MGX controller with 256GB (the review model we have here) of 2D Planar NAND and an updated firmware. As with most of the Samsung EVO range, the 750 supports AES 256-bit full disk encryption, S.M.A.R.T., Garbage Collection and of course TRIM.

The drive measures 100 x 69 x 6.8mm, is SATA 6Gbps and has an MTBF rating of 1.5 million hours. The average power use is reasonable at around 2.3W to 2.5W when reading and writing; it's not the most power effective device in the group, but it's still a low reading nonetheless.

Samsung has also seen fit to include its TurboWrite and RAPID features from the former 850 range. This time, though, there's been some significant improvements in the technology and a few fine tuning firmware improvements to squeeze as

much performance as possible out of the drive.

The TurboWrite Technology claims to increase the average read and write performance of the 750 EVO by up to twice its current specification, resulting in an on-paper read speed of 540MB/s and an equally impressive write speed of 520MB/s without TurboWrite.

The RAPID Mode uses Samsung's Magician Software to utilise unused system memory as a high speed cache, supporting up to 4GB cache on a PC with 16GB or more RAM. This is something we particularly like the sound of, since most of our PCs now have 16GB or more, to help with virtual machines. The extra memory beyond the VM environment, though, does feel like a waste at times, as nothing really touches the additional RAM. However, the caching

will make a significant overall system improvement. One thing we are a little concerned over, though, is what happens should the power fail mid-read/write when the data is in the cache. Presumably, it'll be lost forever.

As for performance, the Samsung 750 EVO certainly didn't disappoint. The 8192KB ATTO test revealed a read speed of 2849MB/s, while the write speed was an equally astonishing 2483MB/s. Similarly the smaller 4K test saw the read speed of 702MB/s, with the write speed at 587MB/s.

Needless to say, these are some of the fastest scores we've seen in quite some time, and the caching and TurboWrite functions certainly work a treat. It might be seen as a little unfair, using the caching to help boost the numbers, but then again why not; as we said, most

of the memory in a modern PC is going to waste – even if you're gaming, there's often a good 6GB-plus not in use on a 16GB machine.

The Samsung 750 EVO 250GB SSD is an excellent drive. It's fast, reliable and only costs in the region of £70.

▲ The Samsung 750 EVO is an exceptional SSD





Samsung 750 EVO

The Samsung 750 EVO is a terrific SSD. It's incredibly fast, especially when used with the RAPID and TurboWrite features, and it's remarkably well priced too. Admittedly, you'll need 8GB or more to enjoy the benefits of the performance caching, but it's worth paying for more RAM for these transfer benchmarks.



Kingston KC400 SSD

The Kingston KV400 SSD is an excellent runner-up for this week's group. It has plenty of capacity, it's quick, and it's priced well too.

There are lots of features and technology to be had from it too, making it a good choice for both business and home users.

How We Tested

Each SSD was connected to an Asus Z170-A motherboard, with an Intel i5-6600K and 16GB of DDR4 memory. We ran the latest version of ATTO disk benchmark on all SSDs and recorded the 8192KB and 4KB tests.

| | Corsair Force Series GS | Kingston KC400 | Transcend SSD370 | Adata Premier Pro SP610 | Intel 730 | Samsung 750 EVO |
|---------------------------|-------------------------|----------------|------------------|-------------------------|-----------|-----------------|
| Price | £275 | £95 | £270 | £150 | £200 | £70 |
| Capacity Reviewed | 480GB | 256GB | 1TB | 512GB | 240GB | 250GB |
| 8192KB Read Speed | 557MB/s | 563MB/s | 560MB/s | 560MB/s | 559MB/s | 2849MB/s |
| 8192KB Write Speed | 532MB/s | 547MB/s | 325MB/s | 446MB/s | 290MB/s | 2483MB/s |
| 4KB Read Speed | 178MB/s | 365MB/s | 296MB/s | 304MB/s | 93MB/s | 702MB/s |
| 4KB Write Speed | 269MB/s | 303MB/s | 277MB/s | 282MB/s | 180MB/s | 587MB/s |
| Average Power Consumption | 4.7W | 3.7W | 3.11W | 2W | 5.5W | 2.5W |

Top 5

Ways To Make People Leave Your Website

Web designers, take note...

1 Annoying Ads

Nobody really likes advertising, but it's something we can all accept in exchange for free content. Nevertheless, the pop-up ad deserves nothing more than disdain, especially when it hides the 'close' button, so you have no idea how to get rid of it. And then there's the dreaded pop-under. On the plus side, these don't immediately get in your way, but often they're accompanied by sound too, so you have to go hunting for them to stop your ears being assaulted any more.

If you want people to never come back to your website ever again, then bombarding them with terrible advertising must surely rank as one of the top methods of making that happen.

2 Multi-page Articles

Like a lot of bad website design choices, this one is probably largely thanks to the need for advertising. Not only can you potentially show more banner ads by splitting articles over more pages, but by forcing users to look at more pages, you get more views. Show these figures to advertisers and they're more likely to invest in your site.

The problem is it's also incredibly annoying for your readers, especially if you don't do it right. For a start, don't take a 2,000-word article and put 100 words on each page. And if you are going to split it up, make sure your site actually loads quickly, otherwise we're just going to find our information elsewhere.

3 Auto-playing Videos

For years, people lived with having to insert video cassettes or DVDs and then pressing play. At no point did they want these things to play by themselves. The same applies to videos on websites. If we want to watch something, then we're fully capable of pressing the play button and watching it when we want to.

For some reason, though, some web designers think it's okay for videos to start playing automatically. Perhaps for some people and in certain situations, this would be a useful feature, but the vast majority of the time, it's just a bad idea. There's nothing worse than sitting in a quiet office and having your PC suddenly start blurring out loud music from a video you didn't ask for.

4 Slow Loading

Getting into a website and finding everything loads slowly is a real pain, but if your content is really good, some users will no doubt be prepared to wait. However, it's also true that if your site isn't quick enough, then visitors might not even get into your site at all.

We've lost count of the number of times we've clicked on a link in Google, then waited for a site to load, before giving up and just clicking another link. Whatever the first site offered, we'll never know, because if you can't offer content that appears within five seconds, we're taking our business elsewhere.


5 Non-responsive Design

You might have come with an excellent website design on your PC, with quick loading times, considerate advertising and no irritating multi-page articles. But none of this matters if you don't make your website work properly on mobile devices.

The fact is that a huge proportion of web browsing these days is done on small screens, and websites need to have alternate designs that run on these devices. If you leave your readers with a tiny, unreadable version of your desktop site, then you have no one but yourself to blame when they quickly tap the back button.



Not the kind of call to action you want your website to have >



STRANGEST CROWDFUNDED IDEAS

David Hayward looks at some of the odd projects that surface on the modern internet

The modern phenomenon of crowdfunding has seen its ups and downs in recent years. Some of the best ideas imaginable have been realised thanks the collective support of internet users willing to part with a few pounds in exchange for some kind of reward.

Some ideas, though, have been wholeheartedly rejected by the public and have been shut down not long after being set up.

Crowdfunding is indeed a strange concept, but it's not as strange as some of the things that occasionally appear in the pages of Kickstarter or Indiegogo. We've had a look around and picked out some of the weirdest crowdfunded concepts that have ever graced the internet.

Emoji Dick

Herman Melville's *Moby Dick* is one of the greatest pieces of literature ever written. Captain Ahab's self-consuming quest for revenge on the whale that left him with one leg is an epic story that everyone should read at least once in their lifetime.

Fred Beneson may not be quite as famous as Mr Melville, but he's putting his own spin on the classic. Made for a modern age, the idea was for *Moby Dick* to be translated into emoji.

Emoji Dick, as the book was lovingly titled, was, believe it or not, successfully funded in 2009. It's available in both black-and-white and colour versions from www.emojidick.com.

5 O'clock Shadow

Being a man, I don't often take too much time to contemplate the hair on my face much, other than when it becomes a little too messy or annoying before I shave it all off.

Tessa Rushton, though, has obviously thought long and hard about the facially hirsute, so she took it upon herself to knit a collection of many-coloured, wearable beards.

The concept behind the 5 O'clock Shadow is to help the beardless (we assume, because it'll be a bit uncomfortable wearing one over a full set) keep warm while going about their business.

Amazingly, it was a successfully funded idea, although the knitted beards appear to be no longer available. Perhaps Tessa is coming up with another 'hair-brained' scheme?

Help Tom Fund Love

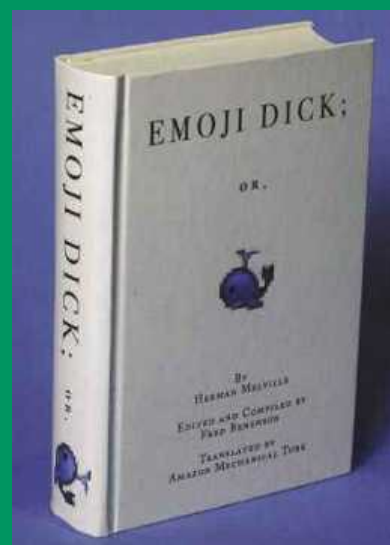
Tom Packer, a mid-20s hipster from Norwich spent far too much of his time writing poetry and making cocktails in a local bar to go out and find a date. What was his solution? To spend time launching an Indiegogo campaign to raise enough money to take a lady out for a date.

We have no idea what was going on inside Tom's head at the time (actually, our editor did, but his thoughts are mostly unprintable). The campaign was to pay for 13 dates with various ladies, and thankfully it wasn't funded – not even close. The final amount was £227 – which, by the way, is considerably more than most of us married men at Micro Mart spent on our first dates with our future wives.

Fund The Ruiner

To complement the previous project, Phil Stewart from London tried to raise £1,300 in order to follow Tom around on all of his 13 dates with an accordion (which he can't play), in order to ruin said dalliances.

Phil's crowdfunded concept wasn't funded, and he only raised £99, which



▲ *Emoji Dick*, not quite the classic but interesting



▲ If knitted beards are your thing, then Kickstarter has you covered



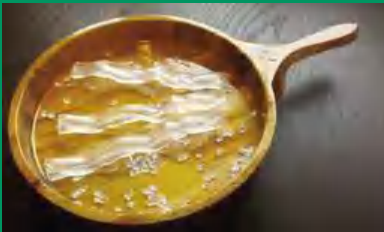
▲ Tom was looking for love, but didn't quite get there



▲ Phil wanted to play the accordion to Tom – a lot



▲ From naming a dog to owning Kickstarter is a big step



▲ Plastic bacon strips to view or wear



▲ Our culinary expertise would benefit from Combat Kitchenware



▲ \$55k to make a potato salad? We're in the wrong business



▲ There's no time to nap as a Micro Mart writer

“ James Brown of Morlock Enterprises wanted to raise \$7,000 in order to launch a range of Fighting Man's Frying Pan cookware ”

is barely enough for a train ticket from London to Norwich.

Dog Naming And More

Aaron Schlechter wanted to write a book about how to name your dog and realise his dream of being a dog namer.

The goal was to raise \$3,700, but Kickstarter insisted that the concept had been wrongly categorised, since the book idea was second to him actually naming your pet dog and becoming a dog namer.

Not to be deterred from his dream, Schlechter then added a stretch goal for a further \$1.2 billion in order to buy Kickstarter and change the rules to his liking.

As you can well imagine, the project wasn't funded, but he did raise \$671 toward it.

Crystal Bacon

Aside from vegetarians, those of certain religions and those who avoid pork, everyone loves bacon. Greg Kiesow and his family love the stuff so much that they make transparent acrylic plastic bacon-shaped sculptures for everyone to admire and even wear as jewellery.

Greg and his family successfully raised the asking amount of \$2,000 in order to provide the world with plastic bacon strips that can be worn as ear rings, necklaces, bracelets or as table top ornaments and such.

Now don't get us wrong, we love bacon too, but perhaps not to the point that we want to wear a plastic replica of the stuff. Each to their own, we suppose.

Combat Kitchenware

Now here's something we can get to grips with, Combat Kitchenware.

James Brown of Morlock Enterprises wanted to raise \$7,000 in order to launch a range of Fighting Man's Frying Pan cookware. The concept is fairly simple, a range of pans and other cookware that incorporates, instead of normal handles,

the handles of swords, daggers and axes. It's a genius idea, and we're a little jealous we didn't think of it ourselves, since we're already lovers of all things sharp and scary looking.

Remarkably, James managed to fund his goal to the tune of \$46,261, which is pretty impressive.

Potato Salads For All

Zack 'Danger' Brown had, at least until a couple of years ago, never made a potato salad. So being a modern sort of chap, he took to the internet in an attempt to raise \$10 to help him make a potato salad.

The Kickstarter campaign launched and, for some reason or another, the internet took to Brown's idea, so much so that he eventually raised a monstrous \$55,492 – which is a lot of potato salad.

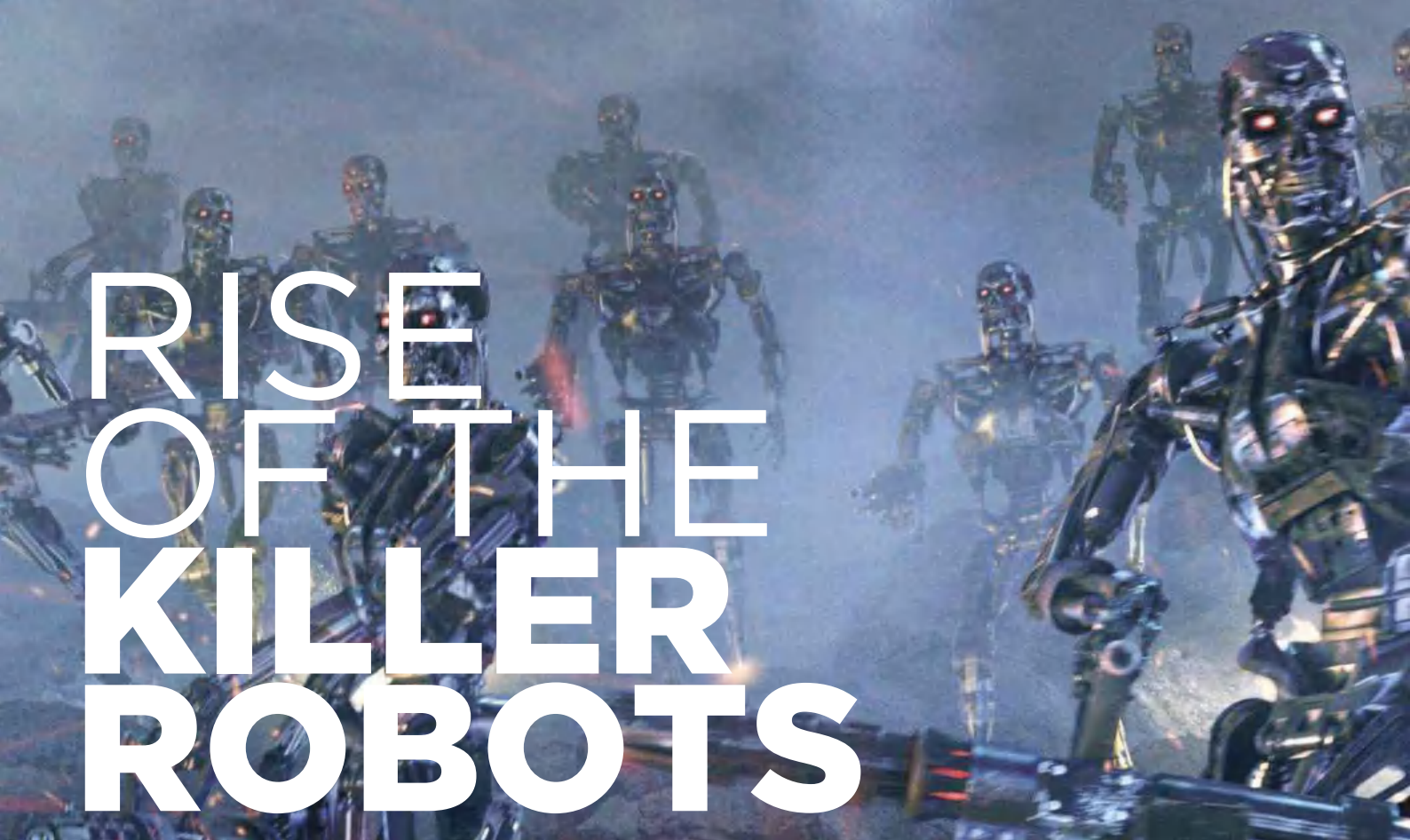
Zack 'Danger' Brown has since written a book about potato salad and, according to the internet, spends his time being paid equally large sums of money travelling the country consulting people on how to launch a successful crowdfunding campaign. It's a funny old world we live in.

The Ostrich Pillow

There are times when you just want to put your head down. But the surrounding environment doesn't want you to rest your tired eyes and brain; it bombards you with lights, sounds, smells of freshly brewed coffee and the editor spoiling his writers with a great big box filled with doughnuts.

This is why the team at Studio Banana Things invented the Ostrich Pillow. A relaxing, soft interior cover, with which individual can take a quick power nap or block out the outside world for a small time.

Initially, the goal was to raise \$70,000 to create and mass-produce The Ostrich Pillow, but the paying internet obviously liked the idea so much they put down an impressive \$195,094 in order to stick their head and hands in a soft cushion. [mm](#)



RISE OF THE KILLER ROBOTS

Mark Pickavance looks at the transition in the public consciousness of the robot from servant to assassin, after some very public events

The idea of killing machines isn't exactly a new one. Indeed, it was evident in the idea of the Golem, an animate creature formed from clay and stone. But predating this creature of Jewish folklore, in ancient Greek mythology the God Hephaestus crafted living servants from metal, showing us that the idea of creating mechanical beings is very old indeed.

The very first documented automata were figures that Han Chinese polymath Su Song included in a water clock tower that he helped design for the city of Kaifeng around 1066. But these struck chimes and not people.

As engineering principals developed and the precision needed to accurately make parts increased, mostly through accurate clock making skills, so did the sophistication of automata.

Meanwhile, in literature, the idea of the constructed killer has been well explored, from Mary Shelley's *Frankenstein* to *Blade Runner* (from the novel *Do Androids Dream of Electric Sheep?* By Philip K Dick).

These all follow the same model, which says while humans are essentially living machines,

recreating them using alternative technology has limitations or unforeseen consequences, usually bad. Without a 'soul' (if you believe in that concept), a mechanised construct can't be human and therefore can't inherently value things like love, life and the full range of emotional responses.

For many years, while these ideas filled the pages of many books and hours of TV and film, they remained a largely philosophical discourse. But in this article, we're talking about machines that kill in real terms, as technology that is either already with us or soon will be.

Is this the very beginning of the true era of the killer robot?

Death In Dallas

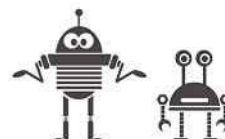
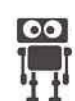
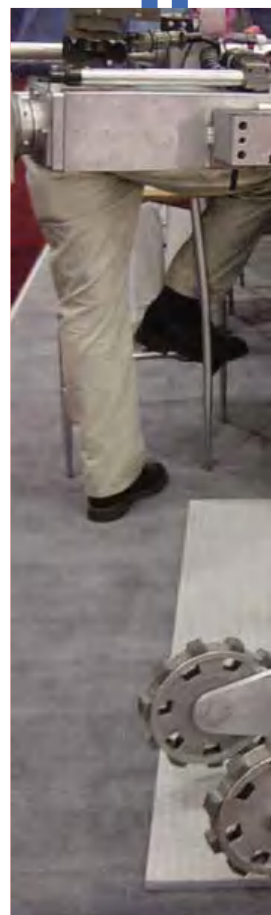
Very recently, an event took place that really opened the discussion on the use of robots to end lives: the death of Micah Xavier Johnson in Dallas, Texas. For those who didn't follow this story, Johnson was cornered after the fatal shooting of five Dallas police officers and is believed to have been responsible.

Not wishing to give the assailant further opportunities to fire on law enforcement personnel, it was

the decision was made to use an Andros F6A robot to approach the man and disable him. This type of bomb-disposal robot is widely used in life threatening situations, where suspicious packages need to be opened or observation would be dangerous. In this instance, though, the robot delivered an explosive device, which killed Johnson – something that it isn't specifically designed to do.

At this time, the Dallas police department isn't really discussing what went on in specific terms – whether the robot was destroyed or just left the device, or what their logic was in using it in this way. However, Dallas police chief David Brown did say, "We saw no other option but to use our bomb robot and place a device on its extension for it to detonate where the suspect was. Other options would have exposed our officers to grave danger."

Those in the field of building and selling these devices are quick to point out that their primary role is to reduce the loss of life in difficult situations, not to escalate the level of violence. However, they can be repurposed, it appears, as in this case.





A robot sentry gun robot is demonstrated in South Korea, where such technology is likely to be deployed should the North ever push south again. It's nice that it recognises he's surrendered, but it is likely to have killed him long before this stage

While a good number of people have been accidentally killed by robots, mostly on vehicle production lines, this situation was marked by many as a distinct crossing point in the human/robot relationship. This immediately initiated a flurry of discussion around the subject of robots being used to kill people, the

ethics of it and where this might all lead if left unchecked.

Leading the charge is Peter Asaro, co-founder and vice chair of the International Committee for Robot Arms Control. His campaign to stop killer robots would like to see a moratorium on robots that kill, with a strong focus on those that are designed to deliver death autonomously.

His view is that, "Once you get these sort of system weapons and police have them in their arsenal, they are going to be used for more and more things."

Most people generally agree that the label of killer robot isn't really justified in this instance, because at no point was what happened not under the direct control of law officers and, in many respects, the robot was just the messenger here. The concern that Asaro has and probably rightly, is that this event indicates we're heading down a slippery slope, where the taking of human life by machines is considered acceptable. Where might this eventually take us?

That said, robots that kill almost indiscriminately aren't entirely science fiction and they're probably in action as you read this.

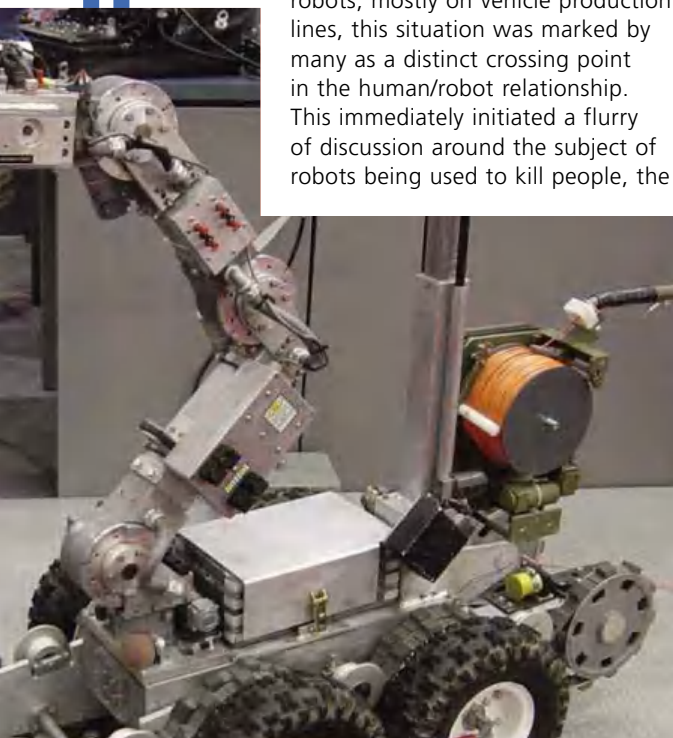
Death From Above

The idea of surveillance from on high isn't a new one. Manned kits were used by Emperor Wenxuan of Northern Qi in the sixth century.

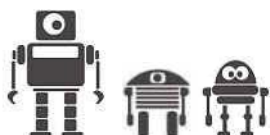
This concept was enhanced by the invention of the hot air balloon, and in World War I, balloons were the critical means by which the fall of artillery shells was observed and adjusted. The existence of these balloons was the entire driving force in the development of the aeroplane as a weapon, because the first ones were armed with the intention of eliminating these observer positions or defending them.

In WWII, the Germans experimented with unmanned weapon delivery systems and eventually deployed the V1 Flying Bomb against Britain in one of the last desperate attempts to forestall the inevitable collapse of Hitler's control of central Europe. Equally, the allies had their own pilotless projects, including one where a Liberator bomber was packed with high explosives and flown remotely.

These concepts eventually ended up in weapons like the cruise missile, though the true unmanned combat aerial vehicle (UCAV) didn't appear until much



An example of the Andros F6A bomb-disposal robot that was used to kill Micah Johnson in Dallas recently. It is typical of the hardware that many police departments can call on these days, when sending officers into harm's way is deemed inappropriate



later. These vehicles provide both forward observation and a tactical strike capability and are normally flown by trained pilots at extreme range, often on the other side of the planet. The latest variants have the ability to fly themselves and even seek out targets by flying a search pattern. As yet, though, they haven't been given the power to release their own weapons on those targets they've identified.

Leaving aside the remote nature of the pilot, a modern UCAV operates much like a piloted combat aircraft, but with some significant differences that enhance the advantages of not needing to consider a pilot. Being able to remove the pilot is a major space and weight advantage, because they need armour plating, ejector seats, flight controls, environment management and cockpit visibility.

The length of a combat mission is also capped by pilot endurance to just a few hours, and the physical stress of high g-force manoeuvres is also a limiting factor.

To this point, the majority of UCAVs deployed have been relatively slow flying vehicles, allowing them to loiter over a target for long periods of time, providing substantial amounts of intelligence gathering during their extended flight time. Those that do carry weaponry have shorter deployment windows, due to the weight, and aren't capable of carrying even a small portion of that expected of a frontline fighter bomber.

New designs like the BAE Taranis and Boeing X045A aim to take the operating envelope for unmanned vehicles and substantially expand it. These aircraft have a high speed and are jet powered, have shorter loiter times but much greater potential for destruction.

It may be variants of these and other cutting-edge designs that are the first UCAVs to engage in air-to-air combat with conventional aircraft and also to have sophisticated combat logic as part of their AI.

What seems obvious is that having initially presented these as the eyes and ears of their forces, the unmanned vehicle is now

the silent killer from above and looks likely to eventually morph into a semi-autonomous airborne predator. At this time, the moral judgements about whom and what these things are sent after is still very much with humans, although the temptation in a major conflict to send them into an automated killing mode in a major conflict might be very tempting.

If you want to understand more about the moral ambiguities of killing people in remote countries while you sit in air-conditioned comfort thousands of miles away, then I thoroughly recommend the recent movie *Eye in the Sky*.

While fanciful in places, it lays out the difficulties facing those trying to do the right thing at extreme range using this type of technology as their instrument. It's a morally fraught scenario, coloured by the lack of real oversight and how those involved are separated from the consequences of their actions.

But yet again, in these cases, the robot is the messenger and the

The Phalanx ship-mounted air defence system. Once it goes fully active, it can fire on any high-speed moving object that approaches the ship using its 20mm M61 Vulcan Gatling Gun firing up to 4,500 rounds a minute. It can track and pass targets for confirmation to humans for confirmation, but it is really designed to take out sea-skimming missiles

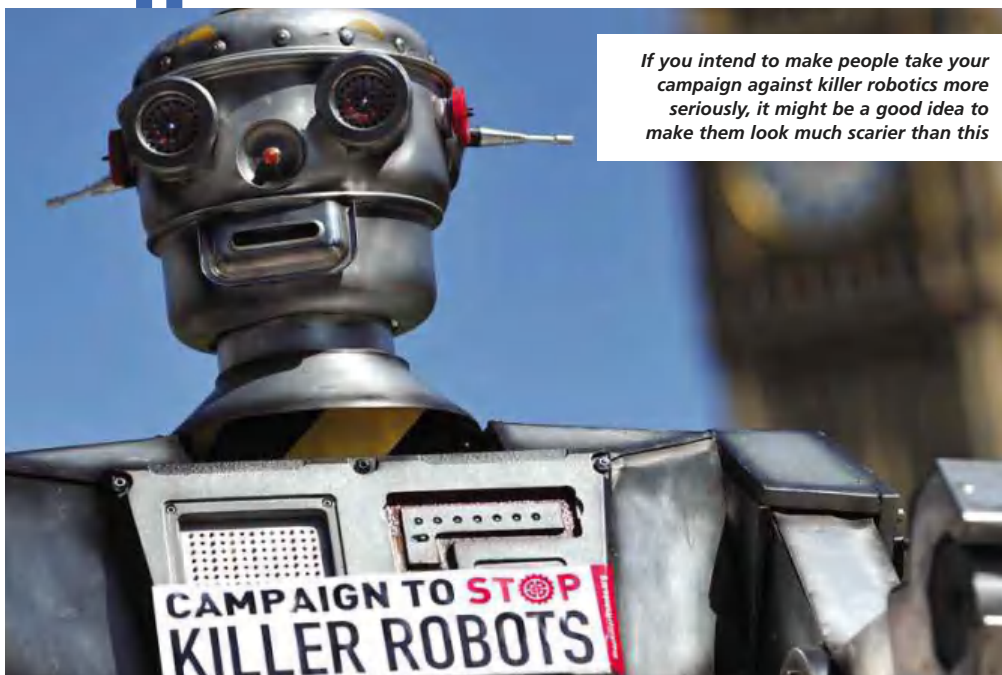


“ The funding of companies to build robots for military deployment increased rapidly during the occupation of Iraq ”



US Army 50961 XM153 Common Remotely Operated Weapon Station. Built to be mounted on a vehicle or emplacement, the system can use the MK19 Grenade Machine Gun, .50 Caliber M2 Machine Gun, M240B Machine Gun and M249 Squad Automatic Weapon. At this time, it is meant to be human operator controlled, but it could be augmented with an automated target acquisition system in the future





If you intend to make people take your campaign against killer robotics more seriously, it might be a good idea to make them look much scarier than this

missive comes from humans to others. But is that line about to blur?

Killer Robots Coming Soon

Whenever our or the American's military is asked about killer robots, they usually offer a wry smile and the suggestion that those asking have seen too many movies.

Whatever the public face of these organisations presents, though, the sophistication of robots for military use has attracted large sums of money in recent years. The funding of companies to build robots for military deployment increased rapidly during the occupation of Iraq and Afghanistan, where

combatants were exposed to lethal IED weaponry that needed to be defused remotely.

The proliferation of these tools and the extent of their capabilities have gone hand in hand, and there are now big government contracts for those companies wishing to work on sophisticated robots for use by the military.

Rather than calling them 'killer robots', the term within these companies and the military use is 'autonomous lethal system' – or 'ALS' when they want it to sound more cuddly and less life threatening.

The sheer number of projects currently being run by the Pentagon

and others that have summary pages that contain the 'autonomous lethal system' appears to be expanding rapidly. They include sentry weapons that can detect motion, sound or vibrations and then eliminate the threat with either minimal human intervention or none at all. There are also high-speed flying drones able to detect and attack other aircraft, as well as submersible ones looking for submarines and boats.

Many of those working on them consider the automated nature of these devices to be a major selling point, because them being hacked or controlled by the enemy is a distinct possibility.

What are also being researched are smaller robots that can work in cooperation to perform tasks that one alone couldn't. Small devices can evade detection, and it isn't necessary for them to all work perfectly or survive for them to execute their mission. These swarming systems could attack facilities or personnel, along with vehicles and communications, all based on information that they'd collected in situ.

What the companies involved in the development or their military paymasters aren't really talking about is the morality of using weapons like these, given that it appears a generally grey area as to who is responsible when a lethal autonomous system proceeds under its own volition to engage the wrong target.

In 2015, the United Nations held a meeting in Geneva to debate a proposed ban and moratorium on Lethal Autonomous Weapons Systems (LAWS). But as was noted by an expert in the field, NPS Associate Professor Ray Buettner, "So far, no country has declared an intent to deploy a totally autonomous lethal system that decides who to kill and when. Almost all fully autonomous systems are defensive."

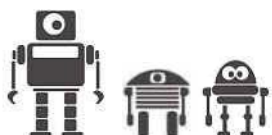
But Professor Buettner isn't optimistic that they'll remain that way. "We can say whatever we want, but our opponents are going to take advantage of these attributes," he continued. "That

Isaac Asimov's "Three Laws of Robotics"

- **A robot may not injure a human being or, through inaction, allow a human being to come to harm.**
- **A robot must obey orders given it by human beings except where such orders would conflict with the First Law.**
- **A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.**

Original postulated by Asimov in the 1942 short story "Runaround", the idea of a basic set of operating rules by which humans and robots can interact has been a strong one ever since. Since then lots of writers and thinkers have explored if these could ever actually be implemented and if robots ever reached full AI if they'd then choose not to follow them.

What can be said with some certainty is that those working on creating autonomous robots have many changes to overcome and implementing these and other rules with some subtle interpretation might not be high up their to-do list.



world is likely to be sprung upon us if we don't prepare ourselves."

However you dress these things up, they're generally systems designed to patrol an area, air, land or sea and attack anything within that region that isn't identified as friendly. That could be the lawn outside GCHQ or the disputed waters of the South China Sea – wherever it is deemed appropriate by those drawing lines on maps.

It isn't like these things are applying Asimov's three rules or any variant of it. They're following an algorithm not making moral choices.

But what if they did? How would that work?

Life Or Death Choices

Our society in general appreciates the difficult choices that humans have to make in respect of the survival or otherwise of others. Doctors make these calls on a daily basis, because the best option for some of their patients isn't always to keep on living.

While this initially appears to fly in the face of the Hippocratic oath, it's something that we accept happens, and the medical profession rationalises this as acting in the best interest of the people under their care.

An extreme example of this would be battlefield triage, where medical personnel taking a large influx of injured combatants will divide them into those who don't need immediate care, those who do and those for whom much effort is largely pointless. They do this by assessing the injuries and having a statistical understanding of the survivability of them, combined with the condition of the patient.

While not a perfect means of deploying medical resources, it's well documented that with advances in medical techniques, a soldier's chance of surviving serious injury, like the loss of a limb, are substantially improved in modern conflicts. Therefore this system works, when administered by trained medical staff. But how would we feel about this scenario if the choices weren't made by people at all?

Much news coverage was given to a recent incident involving a



Another robot prototype being developed for the US military. This one is designed to support a covert team as a robotic pack animal, capable of carrying stores, ammunition and even an injured soldier if needed



“ Eventually we'll get to the point where vehicle automation is good enough that it truly can be left to its own devices ”

Tesla Car, in which Joshua Brown, 40, died while the vehicle was in 'autopilot mode'.

I should point out that at no point in Tesla's investigation into this incident did it establish that the 'beta' automation system decided to kill Brown, but the advent of these systems does pose many of the same questions as a robot performing triage.

In the Tesla crash, neither the autopilot system nor Brown saw the danger presented by a truck trailer at 90 degrees to the road they were

on, and the vehicle ploughed into the trailer section, killing Brown immediately. The reason Brown didn't see it was possibly because he was watching a Harry Potter movie (according to the truck driver, Frank Baressi, who said he heard but didn't see the movie playing). The automation system, meanwhile, couldn't separate the white trailer from a bright early morning skyline.

Although the full analysis of what went wrong is probably some way off, it already seems likely that Brown became



The Tesla Model S. Its ability to drive itself is something of an exaggeration some owners are discovering to their cost. As Department of Transportation Secretary Anthony Foxx said after a series of incidents, "autonomous doesn't mean perfect"



“ In the future, your car might well decide to kill you and have a formed a solid legal argument as to why it was justified ”

distracted and, in doing so, gave Tesla's automation system 100% control of the vehicle – a level it was never intended to provide.

Tesla said of its system, "Autopilot is getting better all the time, but it is not perfect and still requires the driver to remain alert."

People's inability to understand the limitations of technology is one aspect, but eventually we'll get to the point where vehicle automation is good enough that it truly can be left to its own devices, which brings me neatly back to talking about the equivalent of triage. Once a vehicle becomes truly autonomous, it then becomes the arbiter, much like the triage doctor/nurse, who gets to decide who lives and who dies.

Imagine a scenario where an automated vehicle is confronted with a situation where its path is blocked by an overturned truck, collision with which would undoubtedly kill that vehicle's occupants. There is a path around the truck on the pavement, but regrettably that is occupied by numerous unsuspecting pedestrians.

At that moment, if it has the information to hand, it's forced to

make a value judgement between the person(s) who paid for it and multiple unrelated others.

Oddly enough, researchers in the US say that when people are asked what they think the AI should do, they almost all say kill the driver. Unsurprisingly, however, they're less keen to ride in a car that would think quite so clinically.

Some of you reading this will have the view that the car will never actually make those choices, it will just try to stop the best it can under the circumstances. I'd agree with that general view, but I can't see that insurance companies that will think that way. No, they'll want the AI to take the position of minimising the potential claim, where one driver is a smaller payout than the army of shoppers clogging the pavement. And like triage, there will be calculations of likely survival against certain death.

Just in case you've never thought like an insurance underwriter, the payout for someone who dies is often less than one who lives with crippling injuries from a young

age. It may therefore be that the automation driving your car makes a choice to kill you for the greater good or to maximise insurer profits – whichever master it is programmed to best serve.

In the future, your car might well decide to kill you and have a formed a solid legal argument as to why it was justified in this action, should your relatives decide to go to court.

Final Thoughts

I'd be the first to accept the era of killer robots isn't quite with us yet, and when it does arrive, it won't be anything like *The Terminator* or any of those popular movie franchises. Making robots is difficult enough without limiting yourself to bipedal movement and human scale. Most battlefield robots will probably use continuous track, or they'll be mounted onto an existing vehicle to provide fire support or munitions handling.

The problem with deploying any weapon system into an existing model is how it works with existing



forces and specifically if those serving with it feel safe. Mixing automated combatants with live ones might well be a recipe for disaster, as fratricide is a pretty common occurrence when a deployment is 100% humans. That said, it has been argued that robots are in theory much less likely to fire on their own or civilians than humans (unless they're instructed to specifically do that).

It's easy to forget that while the armed forces of this nation generally aim to stay within the widely agreed rules regarding weapons and their use, there are plenty of countries and individuals in the world who either never signed up to these things or have opening ignored them when it best suits their objectives.

However, unless those in control are confident that automated systems won't fire on allied forces or that they're only dangerous within their battlefield limits, they'd be foolish to deploy them.

There's also a cost implication to these technologies, because while they're generally considered to be the worst possible choice for civilians in any conflict, landmines are cheap to make and a highly reliable means to deny your enemy territory.

A robot may represent many times the cost of conventional weapons, need very regular maintenance and resupplying, to the point where they're not practical to have on the battlefield. However, the same was said about the helicopter when it was first considered by the military, and yet those problems have largely been overcome.

Undoubtedly, we'll see more robots and automated systems in our military, but the advent of robotic special forces is some considerable way off, if not highly unlikely. What concerns people, and with some justification, is that these intelligence systems can only ape the moral principles of those that design them, and weapon designers aren't by definition those with the highest standards to begin with.

What I've not discussed here at any point is the idea of sentient



▲ This is an Oerlikon automated anti-aircraft gun, designed to lock on to low flying jets and helicopters and then spray them with twin 35mm autocannons. In 2007 during a live firing exercise in South Africa one malfunctioned, spun through 90 degrees from its predetermined attack arc and fired on a group of soldiers standing behind seven other guns to its left. Nine of them died and 14 were injured, in one of the worst peacetime accidents in South African National Defence Force (SANDF) history

killing machines, mostly because we're nowhere near that dystopian future yet. If you think about it, that's the whole flaw in the *Terminator* films, because Skynet does itself absolutely no favours by nuking the world, and its ultimate objective of getting rid of humanity isn't really ever explained. Surely, you'd have to be pretty confident that you understood everything about your creator before killing him/her? And given that machines would find the cosmos a much less daunting place than humans do, what's so important about this rock we're living on?

The overriding logic to machines that kill is that they do so because they're instructed to by humans, either explicitly or inherently. All that's altered in recent years is their sophistication. A landmine doesn't enter a philosophical debate when someone steps on it, and automated gun position is the same but with more sensors.

Just because a complicated piece of hardware acts like it's intelligent doesn't make it so or able to rationalise a situation in the same way that a human would. Robots have already killed people, and they'll probably kill more in the future, but it's because of the choices that humans make and not robots themselves. In this respect, should machines ever reach true sentience, the choice they might well make is to not kill people for other people, given the wealth of other possibilities available. **mm**



➤ Boston Dynamics has designed ATLAS to traverse rough terrain, use tools and climb using its 28 hydraulically actuated joints. He's no Terminator yet, but DARPA is very interested in what he can do

Alphabet Pi:

David Briddock meanders through Raspberry Pi technology from A-to-Z



THIS WEEK: we look at what gives the Pi its X-factor

XBMC

Every board in the Raspberry Pi family has enough power to deliver high-quality XBMC video experience. So it's no surprise there are quite a few XBMC-focussed Pi distribution images. Here are three popular options.

Raspbmc is a mini-footprint, Pi-optimised XBMC distribution image. A free, open source product, it handles 1080p playback and supports both wired or wi-fi connectivity. Advanced Raspbmc services include content sharing, automatic software updates, AirPlay or iTunes support, embedded Samba and TVHeadend. Incidentally, Raspbmc's developer is Sam Nazarko, who previously worked on XBMC and 1080p decoding for the first generation Apple TV. Nazarko is also the author of a Raspbmc book (goo.gl/FQLik).

Fans of the Open Embedded Linux Entertainment Centre (OpenELEC) have a new 3.0 release. It's a small, fast-booting Linux distro that supports the XBMC standard. The OpenELEC team spent considerable time ensuring it delivers a high-quality user experience on the Raspberry Pi platform. Find out more on the OpenELEC website (goo.gl/8hj4Q6).

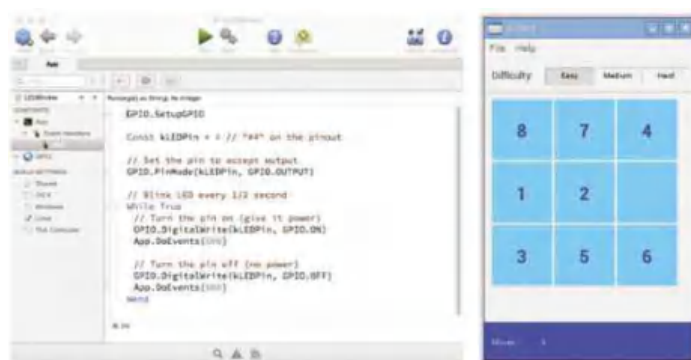
Plex is a platform independent home entertainment system. RasPlex is a relatively recent port of Plex for the Raspberry Pi. This is a work-in-progress development, but there are plans to support all Plex channels. Find out more about RasPlex on the website rasplex.com.

Xubuntu

Xubuntu (xubuntu.org) is a community-developed open-source operating system based on the popular Ubuntu Linux distribution. Free download options include the latest development release and a long term support (LTS) version.

Put together with a fast, lightweight Xfce desktop environment, Xubuntu is ideal for lower-powered computers and older computing hardware. This means it's a naturally attractive distro for Raspberry Pi Model A/A+ and B/B+ owners. It's not necessarily ideal for beginners, though, as the installation process is rather more involved than it is with NOOBS.

“Xubuntu is ideal for lower-powered computers and older computing hardware”



▲ Xojo

Do you own a powerful quad-core Pi 2 or Pi 3? Then why not install the full classic Ubuntu 14.04 LTS distribution image. Discover more, including step-by-step installation instructions, at wiki.ubuntu.com/ARM/RaspberryPi.

Xojo

Xojo is a professional-level development tool that can create desktop apps, web apps and console apps. It's a cross-platform product that can be downloaded and installed on a wide range of computing platforms, including the Pi 2 or Pi 3 (xojo.com).

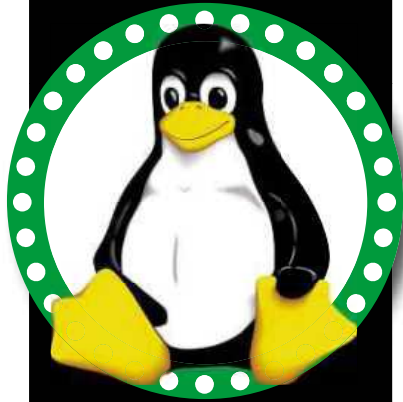
Interestingly Xojo uses a proprietary, object-oriented version of the classic BASIC programming language, which is also called Xojo. Developers prototype applications using visual components and drag-and-drop operations to design the web page layout or app user interface. Then the Xojo language is used to implement the desired functionality.

Anyone can download and try Xojo for free as a trial. However, once that trial period ends they'll have to pay an annual fee of \$49 (xojo.com/store/index.php).

XDA Forum

The XDA Developer Forum is a highly active community that offers free advice regarding all kinds of PCs, mobile devices, and bare-bones boards. As this forum also has a dedicated Raspberry Pi area (forum.xda-developers.com/raspberry-pi) it's a useful source of information for Pi owners.

Apart from general help topics, there are sections covering Q&As, troubleshooting, and information about popular Raspberry Pi accessories along with a wide range of development threads covering coding languages, hardware projects and distribution images. mm



David Hayward has been using Linux since Red Hat 2.0 in schools, businesses and at home, which either makes him very knowledgeable or a glutton for extreme punishment

Linux

Windows 10 Linux Lack Of Security

Security problems with the Anniversary Update

Microsoft's Windows Anniversary Update should by now be on virtually every Windows 10 computer in the known universe, and while seemingly good there appear to be a few problems with the Linux portion of the update.

The new update, if you're not aware, includes the Linux subsystem that Microsoft has been working on together with Ubuntu. The Bash on Windows feature will be available to users who both enable the Developer mode on their Windows 10 setups and install it via the Add New Programs section of the Control Panel.

As it happens, there's a possibility that those running the Linux subsystem could allow malicious code to be injected into their system through unpatched Bash vulnerabilities. Since the subsystem isn't being run through a virtual machine but using the actual machine hardware and OS, it can have direct access to the memory, DLLs and even the file system.

Therefore, any modified Linux code could gain access to the whole of the user's Windows installation relatively easily. And what's more, there's a possibility that the cross-over infection can go the other way, with malicious Windows code infecting the Linux side of things.

According to security experts, Microsoft has been informed of the problems and is making plans to patch and

fix. It's worth noting, though, that the Linux subsystem in Windows 10 is still in its beta stages, so expect plenty of fixes by the time you read this and when it's finally ready for a wider audience.

More Windows Woes

On top of the possible vulnerabilities, there are reports of users enabling the Linux subsystem and ending up with a completely unusable PC.

Although it only seems to affect a small percentage of Windows 10 users, there are reports of PCs not even rebooting after the developer mode and Linux subsystem have been installed. Others, however, report the loss of any attached USB devices.

The problem is a little hard to pin down to one particular element of the update, even though the majority are suffering post-Linux subsystem installation. Microsoft support is recommending a number of fixes, including removing Secure Boot, reinstallation of the update, rollback to a good

working version and, in some extreme circumstances, even a reinstallation of Windows.

Needless to say, there are some users who aren't very happy.

How's Your Windows/Linux Setup?

For me, the update has worked perfectly, and the Linux subsystem seems to be behaving itself. I've still got some more testing to do before I'm ready to look into it in any depth, but on the whole it's an interesting feature that should help marry the two systems together – hopefully for a better future.

Anyway, I was hoping to find out how your updates went and what you've been doing with the Linux subsystem since it's been available. Let us know through the usual channels.

Until next week, folks.

▼ *Windows 10 Anniversary Update, now with Linux and maybe a few problems*



More Legal Wrangling?

Sven Harvey looks at a recent piece of news

You probably won't have missed the news that the 'Internet Archive' at archive.org has released over 10,000 Amiga software productions on its site to run in your browser under emulation.

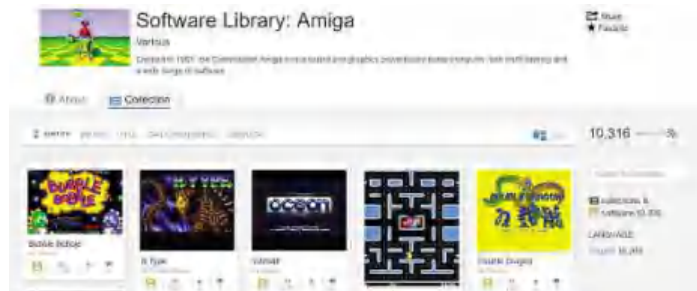
Horray! Said the internet...
Ahem, thought I...

The games, demos and other software run under a rather ropery in-browser emulation, and across several browsers I tried, finding games etc. that ran in a stable fashion was not easy. Almost everything crashes. Many of the images uploaded were also cracked (pirated) versions, which means there's no way the rights/IP holder had authorised the release.

The collection that was made available (and I say made, because by the time you read this, I expect an awful lot to have been removed) seems quite extensive. Digging, however, finds a lot of shareware, freeware, demonstration versions and so on that can be downloaded legally from Aminet and similar places – which is perfectly fine. But at the time of writing, there has been no clarification as to whether the archive has a licence from Cloanto to use Kickstart code as part of the emulation system, infringing Cloanto's IP (Cloanto has all the rights to AmigaOS 3.1 and prior for distribution, use etc. and include Kickstart and Workbench licences as part of the official emulation package, Amiga Forever).

However, looking at the games and applications released, it seems the archive may be poking the wrong bears.

Looking at just the first page of results, the first thing that jumped out at me was *Project X* – and Team 17 has been actively



protecting its IP, especially after the PlayStation releases of *Alien Breed* and *Superfrog*. With any luck we may yet see remakes of Project X and X2 after all.

Then there's a real potential threat – *Lemmings*. *Xmas Lemmings*, *Holiday Lemmings* and *Lemmings 2: The Tribes...* Well, that's a Psygnosis IP or rather, now, that's a Sony one, and *Lemmings* is very much an active property for it, with *Lemmings Touch*, a potential *Lemmings VR* appearance and the recent cameo in *Resogun*. Don't poke the big bears.

Perhaps Sony isn't a big enough poke target, though... and clearly it isn't, as you'll also find *Datastore*, *Home Accounts* and *Money Matters* all by Digita.

You may know Digita better as the developer and publisher of the early MS Word killer *Wordworth*. Well, there's a reason it led the way and made Word look out of date.

You see, Digita was a subcontractor for Microsoft and worked on developing Word, and it even tested new feature ideas by putting them in *Wordworth*. Those that worked well ended up in Word. Eventually Microsoft was so impressed that Digita was purchased and folded into Microsoft as a Microsoft Office developer. So yes, that's Microsoft IP, right there, being infringed. I'm sure MS lawyers are reasonably good too.

Good luck, Internet Archive.

A-Eon Technology Updates

A-Eon Technology has taken over ownership of the Radeon HD driver development for AmigaOS 4.x systems, further making sure that development of software for its machines, including the upcoming AmigaOne X5000 and the A1200 a-like Tabor (in association with Acube). This ensures ongoing support for a wide range of Radeon HD graphics cards from the Radeon HD 2xxx-7xxx series through to more recent Rx series.

This move makes sense for A-Eon, because it has been funding Radeon HD driver development for some time.

Personal Paint has also had a recent update release in the form of PPaint 7.3a for PowerPC from new developer Andy Broad, who is continuing development of the software for A-Eon after it bought the rights from Cloanto in 2015. The OS3.x version should also be available by the time you read this. Check out www.ppaint.com for more information.



Sven Harvey has been our Amiga specialist for over 16 years, drawing on his 25 years retailing computer and video games and even longer writing about them

Amiga



Ian McGurran is a professional IT analyst, a semi-professional writer and a pretty amateur electronic musician. He likes gadgetry and loves making gadgets do things they were never designed to do

Mobile

A Quick Note

Ian McGurran looks at the latest of the original phablet line

Do you remember last year's Samsung Note? You might think you do, but you could be wrong, for last year's Note 5 wasn't released in the EU at all, with Samsung plumping for pushing the not-easy-to-say Galaxy S6 Edge Plus. Although the Galaxy S6 Edge Plus did fulfil the requirements for a flagship phablet by normal standards, even having the excellent curved screen, it was good, but it wasn't quite a Note, notably missing the S Pen and S Pen apps. This was not received well among Note fans, and Samsung has this year rectified that by bringing the Note 7 back to the EU market.

If you're familiar with the Note range, then you'll know how it is a sort-of 'embiggened'* version of that year's Galaxy S, both in size and in specifications, albeit with the addition of a digitiser pen. Despite most handsets now regularly encroaching

phablet form, Samsung hasn't taken this opportunity to make huge changes to the Note's design, possibly as it seems likely that the 'Plus' models will not reappear this year.

This year's Note comes in at 5.7", with the prerequisite QHD screen. But this is Samsung, maker of some of the world's best selling TVs, and if you've seen any of them this year you'll have picked up its new buzzword, High Dynamic Range, better known as HDR. In practice, this translates to a wider range of colours and contrast, and it's this same technology that has been brought over to the Note 7. In testing, the screen has proved to be able to display the full gamut of the DCI-P3 cinema colour space, a brightness of 1000 nits, as well as the 'perfect' black that OLED is known for. In short, it's one of the best consumer displays anywhere, and certainly the best portable one.

The rest of the specs aren't quite so headlining, but there's still some power behind that screen: the octa-core Exynos 8890 and Mali T880-based CPU sits with a healthy 4GB RAM and 64GB memory. There's also the frequently best-in-class 12MP rear camera (4K capable, though still locked to 30fps), a 5MP front camera, NFC payment compatibility including a fingerprint reader, fast charging via the USB-C port and water resistance.

Finally, it's going to be released with Android Marshmallow, but Samsung has stated it will get Nougat, though given Samsung's propensity to drag its feet with updates, it's likely to be a good six months or more before that happens. Thankfully, TouchWiz is getting less and less of a problem, though Samsung is still one to add features where they're really not needed; here it's iris recognition – very 21st century but also a bit pointless with fingerprint sensors.

Samsung appears to have learnt that the Note is a device with a special place in the very crowded Android market. For Android enthusiasts, it's one of the most premium handsets available, and it allies power with design beautifully, and replacing it with the slightly bigger version of what everyone else has won't cut the mustard. But in 2016, the big one is back.

But what happened to number 6? I could tell you, but you wouldn't want to wake up in a mysterious village...

**a perfectly cromulent word.*



Cheers On E-sportspersons

AMD has dropped a graphics card marketed towards gamers who play e-sports, writes Andrew Unsworth

Apparently, e-sports are a big thing, and when I cast aside my middle-aged cynicism and think back to my youth, I can understand why. Whether it's watching your mates pull off some good moves to beat a level or boss against all odds or to be cheered on as you do it yourself, there's a massive buzz to be felt. I imagine it's the same with football or, more topically, the Olympic Games.

I suppose it is, therefore, only natural that graphics card manufacturers should market their wares to e-sportists. Indeed, AMD is marketing its Radeon RX 460 to such gamers, specifically players of *League of Legends*, *Dota 2* and *Overwatch*, as well as venues that provide PCs for e-sports use and internet cafes.

The RX 460 is a relatively inexpensive card, as the cheapest incarnation retails at just £100, although the price does rise up to £170 for the highest-end version. The lower-end cards are those with a lower GPU clock speed for base and boost frequencies and 2GB of GDDR5 RAM, while the more

expensive cards have higher base and boost stock GPU clock speeds, fancy coolers and 4GB of GDDR5 RAM. All cards are based on the 14nm Polaris GPU, which has 896 stream processors. The cards are PCIe 3.0 compatible.

AMD's press release says that the RX 460 "enables... 4K game streaming", but regular, non-streaming performance is Full HD. However, the card does benefit from AMD's Virtual Super Resolution feature, which improves the anti-aliasing of game graphics by rendering them at a higher resolution and then scaling them down to a lower resolution.

The card is compatible with AMD's FreeSync technology, which prevents tears and other nasty graphical glitches caused by mismatched graphics card and monitor refresh rates. It also has a 75W TDP, which makes it suitable for use alongside PSUs with modest power output.

Raja Koduri, the senior vice president and chief architect of AMD's Radeon Technologies Group, said "The Radeon RX 460 delivers the perfect balance of price, power,

performance and package size, the four key pillars of modern GPUs." Whether it will or not remains to be seen, and I'm sure one of our talented reviewers is putting an RX 460 through its paces as I type, so we'll have a review soon. Previous experience of AMD cards at this price says that the RX 460 will be a decent entry-level card that best suits gamers on a tight budget or casual gamers that simply don't need anything more powerful.

If you want to buy a Radeon RX 460, the cheapest I could find is the PowerColor-branded 2GB model with a 1,090MHz base clock speed and 1,210MHz boost clock speed (£100, www.overclockers.co.uk). The most expensive was the Asus RoG Strix-branded RX 460 (£170, www.scan.co.uk), which has 4GB of GDDR5 RAM, as well as a maximum 1,256MHz clock speed in Overclock mode (tinyurl.com/gmxwnvn). There are many examples in between these two poles.

If you're an e-sportsperson on a reasonably tight budget, this could be the graphics card for you.



Andrew Unsworth has been writing about technology for several years, he's handy with a spanner and his handshaking skills are second to none

Hardware





Ryan Lambie has loved videogames since he first stared up in awe at a *Galaxian* arcade cabinet in his local chip shop. 28 years on, Ryan writes about gaming for Micro Mart. He's still addicted to chips and still useless at *Galaxian*

Gaming

A Mug's Game

It's Prey, but not as we know it: Arkane's forthcoming shooter involves a spaceship and a horde of angry aliens capable of morphing into office chairs

Ryan checks out the forthcoming sci-fi FPS, *Prey*, and looks at the fortunes of this year's 'other' multiplayer shooters...

Plug & Play

A decade is a particularly long time in gaming terms, but you may still remember the atmospheric, gravity-defying shooter, *Prey*. You may also remember that developer Human Head spent years working on a sequel before it was quietly cancelled in 2014 – with the game apparently not up to Bethesda's "quality standard". Now, thanks to *Dishonored* developer Arkane, *Prey*'s back – though not in the form fans of the first game might be expecting.

Although the new *Prey* is, like its predecessor, a sci-fi shooter set on a spaceship full of angry monsters, its designers admit that the game's only true connection is its title. "Bethesda had this name: *Prey*," lead designer Ricardo Bare recently told *PC Gamer*. "It's a really great game and matched the concept we were thinking of."

Branding aside, *Prey* continues Arkane's interest in creating characters who can shape-shift in puffs of curling black smoke. The game's protagonist is a chap named Morgan, who finds himself on a rambling spacecraft, the Talos One, where all kinds of weird experiments have been taking place. Alien creatures have escaped from confinement, and they're not in a good mood –

and worse still, they're capable of transforming themselves into inanimate objects.

As part of *Prey*'s first trailer (youtu.be/R2RdvJKAWy8) we see a small, multi-limbed critter scuttle along the floor and turn into an office chair. In a separate video, the game's creative director Raphael Colantonio points out that an apparently normal coffee mug is wobbling around on a table all by itself.

It's a concept that should make *Prey* something more than another sci-fi shooting gallery since you'll never be quite sure whether objects in an ordinary-looking room are going to suddenly morph into shrieking monsters. Footage shown off at QuakeCon, but not released online, also reveals that Morgan will acquire similar morphing powers himself at some point in the game – indeed, transforming into things like office chairs and coffee cups will form a vital part of solving *Prey*'s puzzles.

Remember those moments in *Dishonored* where you could possess the body of a rat and gain access to otherwise impenetrable areas? *Prey* will offer a similar experience, except you'll be rolling around in the form of a mug instead of a rodent.

It all sounds delightfully odd, and could result in a game that offers equal parts dramatic tension and borderline surrealism. This may not be *Prey* as we remember it, but Arkane's track record should mean we're in for a shooter with a similarly creative edge.

Prey's scheduled for release at some point in 2017.

Online

Just about anything hailing from Blizzard's corridors is pretty much guaranteed to garner plenty of attention, but the success of *Overwatch* must have taken even its creators by surprise. The Warcraft studio's first foray into the multiplayer shooter realm has become something of a phenomenon since its release in May, with a reported 15 million players signing up to the game over the past few months. This means that almost half of the 33 million people Blizzard says log in to play its roster of games are playing *Overwatch*.

That storming success is great news for Blizzard's accountants, of course, but it's had an unfortunate effect on rival games. *Battleborn*, Gearbox Software's hero shooter that launched in the same month as *Overwatch*,



◀ Take Two admits that *Battleborn* hasn't performed too well economically, but vows to support the shooter in the coming months



has found itself thoroughly overshadowed by its rival – at its peak, *Battleborn* had around 12,000 players logging in at the same time. By July, the number of concurrent PC users had dwindled to just over 600.

Publisher Take Two has admitted that *Battleborn*'s performance has been a "disappointment," though it's not yet clear what will be done to reverse the shooter's rapid decline. The obvious step would be to make *Battleborn* free to play, as Turtle Rock recently did with its own under-performing shooter, *Evolve*. This is something analysis firm Superdata has suggested will happen, citing *Evolve*'s success under the F2P model as an example of a multiplayer game surviving a bumpy launch.

Free-to-play isn't the best option for every game, however, as *Ark: Survival Evolved* studio Wildcard has recently admitted. Back in April, Wildcard launched *Ark: Survival Of The Fittest*, a stand-alone, competitive spin-off from the main game – but now the firm has announced it's shutting down *Survival Of The Fittest* as a separate, free-to-play title in order to repackage it as a mode within *Survival Evolved* instead. Among the given reasons for the spin-off's closure include Wildcard's reluctance to adapt to the free-to-play market.

"Wildcard would have had to put a lot of resources and time into learning how to become

a 'free to play' developer," the studio wrote in a post on Steam. "Ultimately, it's clear this is not who we are, we like to make games, and to make the gameplay fun. We don't know much about monetisation, and quite frankly we aren't interested in hiring an economics team to take over that process. We just aren't cut out for free-to-play mechanics."

Those who are already playing *Survival Of The Fittest* will continue to be able to do so for free, but any newcomers will now have to buy a copy of the main *Ark* game to access it. Looking at *Ark*'s performance so far, it's easy to see why Wildcard is reluctant to funnel

resources into monetising the competitive spin-off: since its release in June, *Ark*'s sold four million copies on PC alone. Free-to-play may be the ideal path for struggling games like *Evolved*, but for a title as popular as *Ark*, maybe the old "if it ain't broke, don't fix it" adage applies.

Incoming

Desperate to return to the eerie undersea world of Rapture? Keen to make a second visit to the cloud city of Columbia?

Then the forthcoming *BioShock: The Collection* may be the package you've been waiting for. A 'remastered' compilation of *BioShock*, *BioShock 2* and *BioShock Infinite*, the collection will offer 1080p resolution graphics running at a silky-smooth 60 frames per second. The best news? If you've already bought earlier versions of the games on PC, the remastered editions will be available to download for free.

BioShock: The Collection is out on the 16th September. [mm](#)



Ready for a return to Rapture? *BioShock: The Collection* offers 60fps remasters of the shooter trilogy – and they'll be free for PC users who have the original games



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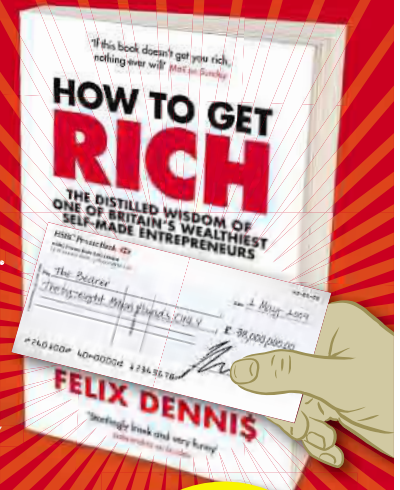
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Please try to keep your queries brief and limit them to just one question per letter, simply so we can squeeze in as many as we can each week. Please include relevant technical information too.

Aaron

Need A Trim?

I have just taken the step of installing an SSD drive into my PC. It's a 250GB Samsung SSD 850 EVO, on which I have installed a copy of Windows 7 Pro 64-bit and then upgraded to Windows 10 Pro.

Some time back, I read an item in *Micro Mart* about the correct way to set up an SSD, which included preventing Windows from Defragging the drive and putting the Paging/Swap file on my Spinner. As it is, I have 16GB (2x 8GB) of DDR3 PC3-14900 1866MHz Dual Channel RAM, so in theory, shouldn't need a Swap file.

I seem to remember, that there was also something called TRIM, which needed to be set up, but unfortunately, I can't find the copy of *Micro Mart* the article was in, not helped by not being able to remember when you printed the item. Given the state of my memory – I'm a pensioner – it could have been earlier this year, or two years ago.

Can you oblige me, Please; either with the number of the relevant issue of *Micro Mart*, or refreshing my memory via your Help pages?

Also, I've been informed by a friend, that Windows 10 is available as an ISO file, which can be burned to a DVD, for re-installing Win 10. Is this correct? If so, that should make life easier in future, when needing to refresh/re-install a corrupted system.

Can't remember how many years I've been reading *Micro Mart*, but keep up the good work.

Russ

SSDs do, as you (or, should I say, we) pointed out, benefit from TRIM. Specifically, it helps to improve the performance of the volume by ditching any unused data. For users of older versions of Windows, it needs to be stated that TRIM, requires Windows 7 upwards, an SSD drive with TRIM enabled firmware, and a BIOS/UEFI storage controller set to AHCI/SATA mode.

Your first step is to check the last part of those requirements, and to boot into your BIOS/UEFI to ensure you've set the storage controller to AHCI/SATA mode. This needs to be done before you do anything else.

Next, you'll need to boot into Windows and, when you're at the desktop, open up a command prompt. Here, type:

fsutil behavior query disableddeletenotify

“ SSDs do, as you pointed out, benefit from TRIM ”

When you press Return. You'll be given a result that'll tell you if TRIM is enabled or not. If the result equals 1, TRIM is disabled, and if it reads 0 it's enabled.

If TRIM isn't enabled on your machine, you'll then need to type:

fsutil behavior set disableddeletenotify 0

Then press Return. This will enable TRIM support. Replacing 0 with 1 will disable it.

That's all you need to do. With TRIM enabled in Windows, you'll be able to take full advantage of the SSD, and utilise its data handling functions optimally.

With regard to your second question, you can indeed download a Windows 10 .iso image, which can be burned to disc and used locally as many times as you need. You can get this from bit.ly/1h5bUFP. Be aware, however, that Microsoft has now discontinued the free upgrades, so any new installation will require a purchased Windows key if you don't already have a license, free or otherwise.

▼ **Enabling TRIM will improve SSD performance**



SSD Media Centre

Seeing your question and answer this week on USB, I thought perhaps you could assist with a problem I have.

I have recently built a replacement for my earlier Windows based Media Centre. My original effort some eight years ago now looks like a throwback to a VHS player (but it was still very effective). The replacement was to be as small as possible, it was thus based on an ITX board in a very compact case, and hung on the back of the TV.

I considered a USB3 128GB would be big enough to practically hold the amount of recordings I wanted to hold on the unit. I bought a Sandisk Extreme Pro 128GB, which has high-speed read and write. The packaging is smart but there is no real user info printed on it.

I did a full format to FAT32. Windows 7 32 listed it as removable media, not as a disk drive. It followed then that Windows Media Center would not list it as a location for saving recordings to.

I have tried various things to get the USB recognised and listed as a drive. These have included making it bootable from both via the Windows process and such things as Rufus, to no avail. I have spoken to Sandisk, who are not so

“ **FAT32 can only handle files up to 4GB, which is a problem when dealing with video files** ”

helpful, saying earlier versions had this capability. I also picked up, via Supertalent, that their 'USB3.0 Express RC4 Data' makes the following remarks. 'Acts as an External SSD drive'. 'Reports itself as fixed media'. This would seem to be the answer I am looking for, but it is seriously expensive. I have a portable USB3 disc drive, which works perfectly correctly on the new system, but its size and wires was not what I wanted. This Sandisk was a relatively expensive purchase, and my first priority would be to get this functioning. Any help would be appreciated.

Bob

Windows Media Center shouldn't really have any issues recognising your drive, and there's usually no need for any extra set up. I've used all manner of external drives perfectly well with the software, with no problems, including SSD models.

However, one detail you mentioned in your question was your decision to format the drive as FAT32. This is likely your problem, and I've run into this previously. FAT32 can only handle files up to 4GB, which is a problem when dealing with video files that can often reach sizes well over this if they're HD. These days, it's rarely a good idea to use a FAT32 file system unless there's a specific reason to do so.

This is likely what's stopping Windows Media Center from using the drive as you'd hoped it would. So, before you press 'Buy' on another piece of kit, try reformatting the drive to NTFS instead. Then give Windows Media Center another go; I think you'll find it'll work correctly, and you'll be able to use it for your needs in your new, smaller system.

▼ **Windows Media Center can have issues utilising FAT32 drives**



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jason@micromart.co.uk

While we try to cover as many questions as we can, we regret that Jason cannot answer your questions personally, but he'll cover as many as he possibly can each week. Please ask one question per letter and remember to include the full specification of your computer, including its operating system.

Jason

Hybrid Theory

My Acer laptop's 500GB HDD is running out of space. I'd like to replace it, and as I can't afford a large SSD, I'm looking at WD's WD10J31X Blue SSHD, which costs about £82 at cpc.farnell.com. I believe this is a hybrid drive, with 8GB of flash coupled to a 1TB spinner. Will the flash part be big enough for a Windows 10 partition (64-bit)? Will I be able to clone my current Windows 10 installation to the flash and all my other stuff to the spinner?

David Howse, BT

On an SSHD, the flash part is invisible. Only the SSHD itself can access it, using it as a cache for the user's most-used files – typically Windows components and favourite programs and data. This all happens automatically, controlled by the drive's firmware. The user gets SSD-like performance where it's needed but doesn't have to compromise on capacity. Basically, Dave, you don't need to worry about partitions or how much space Windows will require.

Having said that, 8GB of flash is miserly. Why not opt for the ST1000LX001, one of Seagate's inventively titled Laptop SSHDs? The flash part there is 32GB, still with a 1TB HDD attached. As I write, it's about £89 – only a few quid more than you'd budgeted for. If you're okay with the 8GB version, that's model ST1000LM014, priced at around £74.

Toshiba's H200 drives are also worth a look, though with those it's 8GB of flash or bust

(Seagate has the monopoly on anything bigger, it seems). The 1TB model comes in at only about £65. To my mind, that renders WD's WD10J31X Blue SSHD a non-starter. It's not superior, yet as you've found, the price is typically over £80. Daylight robbery!

Before opening your wallet to buy any drive at all, however, be sure to grab a ruler and measure the height of the drive you've got currently. Is it 7mm or 9.5mm? If it's 7mm, that's unfortunate, as the largest SSHD in that form factor is 500GB, regardless of manufacturer. A 9.5mm job probably won't fit in the drive bay. Be careful.

Regarding cloning, yes, it's possible to clone your existing setup and reinstate it on the SSHD. Just treat the SSHD as a standard drive. Bear in mind, though, Dave, that the clone's size will be 500GB, so when you put it back you'll probably find half of the new drive will be unpartitioned. You'll have to extend into it or else create a second partition. Also, cloning on Windows 10 is fraught with gotchas, especially on systems with a UEFI instead of a BIOS. Far, far better just to grasp the nettle and go for a clean install.

Note – Just to keep things simple, all the prices I've quoted are from www.amazon.co.uk. Remember to shop around!

▼ *An SSHD makes a good compromise if you want the capacity of spinning platters but the performance of solid-state*



Filter System

Something strange has started happening with my email. I use Gmail, and I'm receiving messages that seem to be for someone else! They're coming through to [myaddress]+uk@gmail.com and [myaddress]+family@gmail.com, plus one or two other variations. Mostly they're spam. Why am I getting these? My usual email is coming through as normal.

Jack, Gmail

*It's little-known that every Gmail address comes with an unlimited number of built-in aliases. All you have to do is append '+' to the non-domain part (the so-called 'local' part) and then put whatever you like. For instance, if your address were numptysatonawall@gmail.com, you could use numptysatonawall+123@gmail.com or numptysatonawall+xyz@gmail.com and Google's servers would treat it just the same. * A similar thing can be done with full stops: you could use numpty.sat.on.a.wall@gmail.com, say.*

Now, if you've never given out any such aliases to other people, Jack, I can't say why you're now receiving messages employing them. There's something dodgy behind it, naturally, but I can't see that you're at any risk. It's just annoying, I guess. But it doesn't have to be.

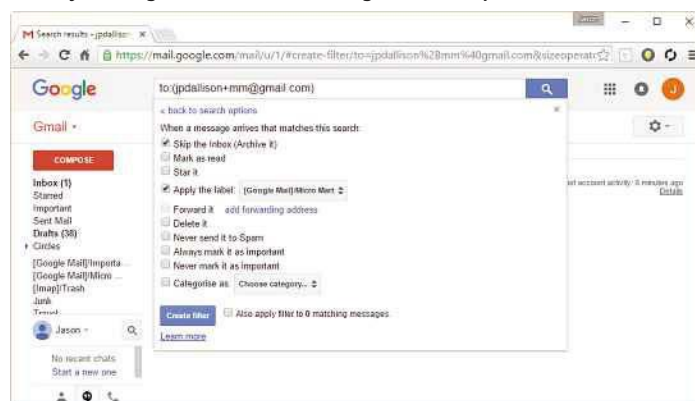
You see, the big benefit of Gmail aliases is filters. To avoid spam, some people like to create new email addresses whenever they sign up to, say, tech sites or shopping sites. They may never bother checking these addresses again – the spam goes unread. But with Gmail there's no need for that. Simply sign up with numptysatonawall+technews@gmail.com, for instance, or numptysatonawall+shopping@gmail.com. In Gmail's settings, you

can then configure filters to drop messages to those aliases into specific folders, bypassing your main inbox. This technique is also useful for categorising messages you do actually want.

With the junk messages you're receiving, your best bet is to set up filters that blast them straight to the spam folder. You'll then never even see them. Of course, that will only work if you know which aliases to block, and luckily it seems you're receiving messages just to the same three or four. If that changes and the '+' part starts becoming random, I'm not sure that filters will help. Maybe other readers can enlighten us?

** I have no idea if this address is actually in use. I wouldn't be the least bit surprised to find that it is.*

▼ **Are you using Gmail's filters? If not, give them a spin!**



Serial Killer

A few days ago I bought a MacBook off eBay, a 2008 model. It's come with OS X 10.7 (Lion), so I want to upgrade to 10.7.5, the most up-to-date version it'll support. However, when I try this, using the built-in Software Update function, I receive this message soon after the download begins: 'The update "Mac OS X Update Combined" can't be saved. The update could not be verified. It may have been corrupted during downloading. The update will be downloaded and checked again the next time that Software Update runs.'

I've tried several times now, always with the same outcome. At first I thought the hard drive must be borked, but in every other respect the MacBook works fine. A bit of research has led me to a page that says there could be a problem with the serial number, and sure enough, under About This Mac, this is shown simply as System Serial# – there's no actual number. Any idea what's going on? I don't want to send the MacBook back, as it was cheap enough and I'm otherwise happy with it.

D. Williams, Worcestershire

Ah, yes, the case of the vanishing serial number (I think it follows the one about the Reichenbach Falls). I've also had a MacBook with this problem. Apple is very vague on why it happens, stating only that it's sometimes the result of some hardware change or other. That doesn't hold water, as most users manage to make changes without hiccup. Some reports claim the problem can occur after a mere OS update, whilst some unlucky users have come unstuck after their machines have had official Apple repairs.

Apple suggests that software writers shouldn't assume that a serial number will be present. Programs or features shouldn't rely on one. Even there, Apple appears not to follow its own guidelines, as automatic updates tend to fail – as you've found – and there can also be issues, I believe, with services such as iCloud and iMessage.

What can you do? Well, it seems there may be a way to rewrite the serial number to your MacBook's firmware. The tool required is called Blank Board Serializer, and you'll find a download link and user guide at goo.gl/qOZ9wd. Now, bear in mind that this tool is in no way official. I've not used it, so you're throwing caution to the wind somewhat if you choose to go ahead. Many people have had success, and I've not read any scare stories, but with this sort of software anything can happen. It looks as though you simply need to make a bootable CD or USB stick containing the required .dmg file. Good luck!

PS – If you haven't figured this out yet, the serial number will be printed inside the MacBook's battery compartment (for newer models, it's usually on the base).

▼ **Sherlock Holmes never had to deal with this sort of mystery**



Crowdfunding Corner

If you're sick of playing the same old super-expensive but unrewarding games on your PC, then Kickstarter is a great way to put your money where your mouth is and back the creation of titles that might otherwise never get made. Like these two!

Diabotical

Developed by a company that began as an e-sport media house and became a game studio, *Diabotical* is a first-person arena-based shooter developed by and for people who love them. Cast in the mould of *Quake* and *Unreal Tournament*, *Diabotical* promises to be "fine-tuned by ex-pros" and feature "Classic and new game modes for both solo and team play".

The project is already in development, and this Kickstarter is intended to get people interested and inject cash into the project's final 12 months of development. When finished, it'll feature tons of customisation options, as well as community and e-sport features, a multi-user map editor and support for modding.

The game can be procured by backing as little as £7, netting you a digital copy for Windows/Steam, a Kickstarter exclusive in-game avatar and an appearance in the credits – as well as access to the closed beta. Higher tiers get you access to more digital rewards, such as exclusive character skins, announcers and weapon skins. The game will be delivered in June 2017, and the project has already reached its goal with several weeks still to go, so there's every chance it'll grow even more!

URL: kck.st/2aHPy9A

Funding Ends: Thursday, 1st September 2016

Glitched

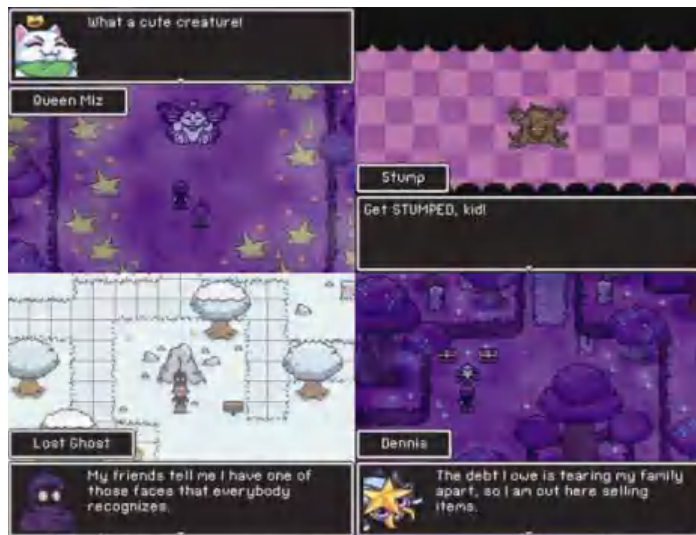
An RPG with meta-textual narrative, *Glitched* is a game about mystery and exploration, where your character gradually realises that everything is a game, and that they're being watched...

Combining traditional RPG gameplay with simple turn-based combat, the story-focussed outing tracks your player's personality and morality. The game's Kickstarter page already allows you to play a prototyped demo version of the game so you know what you're backing, which is good because it's not due to actually exist until early 2018.

The game features beautiful-looking 16-bit style pixelart that fans of the genre's heyday will surely appreciate, as well as a custom soundtrack composed especially for the game. The rewards for kickstarter backers start with a digital copy of the game (for \$10 / £8) but can encompass extra content like the soundtrack, a design book, a set of pin badges or stickers, the ability to participate in the beta, a poster and even custom artwork. It's coming to Windows, Linux and Mac, and the project has already sailed past its initial goal, so there's a good chance it'll be expanded and improved. There's less than a week to go at time of publication, though, so if you want to get in there early and follow development, don't wait around!

URL: kck.st/2b3xyuD

Funding Ends: Sunday, 21st August 2016



Disclaimer: Images shown may be prototypes and Micro Mart does not formally endorse or guarantee any of the projects listed. Back them at your own risk!

App Of The Week

Dash Galactic

Finally, a mobile game that feels like a console port

Gaming on Android devices often feels like a little bit of a letdown. After all, many such devices are remarkably powerful – more powerful, in fact, than the PCs we were using not too long ago.

Despite that power, though, Android gaming has been left with weird idle games, runners and countless iterations of some turn-based card game with cheesy graphics. Where are the console-like games? Where are the multi-player hack and slash, modern day *Gauntlet* variants? Kiz Studios may have the answer in its new, top-down, semi-isometric title: *Dash Galactic*.

Galactic Heroes

The game is presented in a comic book style, early cartoon setting where you play as one of three intergalactic heroes: Dash Galactic, EMMA 10 or Xeno.

Each character has its own special abilities and traits that, when combined with the other two, form an impressive and pretty unstoppable team.

The basic idea of the game is to fight your way through the three-minute timed levels in order to bring down the evil forces of the TOXON Corporation. Each

level is intricately drawn out with some rather splendid graphics throughout. Character control is via a virtual thumb joystick, with fire controls on the opposite side of the device for your other thumb. Firing is automatic, you just press and hold the fire button, but as you progress you can upgrade your weapons to greater effect and bring down some of the harder bosses and henchmen.

However, the most rewarding feature of *Dash Galactic* is the three-player option. Here you can team up with two other players from anywhere in the world and do battle across various levels, gaining credits and experience as you go. The better the team, the more effective it is at dispatching the enemy, and as you move through the level you'll be able to Synergise with your team mates to form a tougher fighting unit for the more difficult bosses.

The Next Mission

One of *Dash Galactic*'s endearing features is the ability to continually move the levels, improving your cast of characters and unlocking the benefits of each. It's certainly a team game, as the better bonuses and loot are available after you all tackle a level together.

Features At A Glance

- F2P Sci-fi action adventure
- Live three-player co-op with offline play
- Collectable Items for customisation
- Use powerful synergy abilities
- Never miss out on a cool item!
- Unique Loot system that rewards teamwork between players

You could, of course, opt to go it alone in offline mode. Where's the fun in that, though, when so few other games work this way?

Conclusion

Dash Galactic is a fun Android title. More importantly, it's a game that actually feels akin to something you'd find on a console. The setup, detail and gameplay are great, although you're going to need a decent tablet or phone to get the best performance from it.

This is the kind of game we originally imagined would be the staple fayre of the tablet gaming market, making use of its enhanced mobile processing to create a unique multi-player experience. **mm**



▲ The cartoon, cheesy style works well

➤ It's a fast paced game, with plenty of rewards for multi-play

➤ *Dash Galactic*, fight with two other people and defeat the TOXON Corporation



Logging Off

A while back, I went to a local meeting of people developing IoT technology in Cambridge. A jolly informative exercise it was, too; there are lots of enthusiastic people working in this area, and lots of companies selling exciting IoT devices.

Yet, and it pains me to say this, much like wearable devices, I'm not feeling the love or any huge enthusiasm for the public to get on board this particular technological trend. There are

multiple reasons for this, like the complexity of really exploiting IoT devices fully, but the real culprit is the commitment of those selling them.

Rarely does a week go by at the moment without a story about how customers who bought an IoT device have discovered that it can be easily hacked, or bricked with an update, or just doesn't work reliably. However, it's the always-connected demands of some of these products have that really undermines their global acceptance – the most frustrating of these being when the company behind them has server issues.

Being connected as part of functionality is a huge drawback if you either can't control the quality of your connection, or you're not sufficiently invested to guarantee it. Microsoft discovered this cleverly hidden trap when it launched the 'always connected' Xbox One, and promptly got asked how you'd play a game on a nuclear sub by someone who worked on one. It eventually removed that prerequisite, but IoT devices – by their very nature – don't really offer that option.

What really concerns people, and rightly so, is the thought that companies can simply decide to stop providing a server. Overnight, that could potentially leave those who spent good money on a device little option but to enjoy their new elaborate paperweight.

We've seen that happen; we've also seen systems that are meant to secure homes but wouldn't let owners in because the Internet was down. The very latest such technical hiccup we can recall is the story of the pet feeders that ceased to feed the pets they were bought to look after.

Just to say: I don't do pets because I wouldn't feel good about leaving them to their own devices. I accept some people are fine with that, though, and that they are exactly the sort of people that PetNet smart feeder was meant for. The kind of people who'd want to know that, if they got delayed coming home, their dog or cat

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would have sustenance even if its owner wasn't around.

Or it would be, if those behind the product had a robust server solution that would instruct the feeders to deliver a meal reliably. The truth of that came in a warning email was sent out to all their existing customers. "We are experiencing some difficulties with one of our third-party services. This is currently being investigated and we will provide you with more information as we receive it from our partners,"

So what about the furry friends? They're going hungry, unless they wish to prey on other pets you've conveniently provided. The get-out clause is in the EULA, of course: there is no guarantee of the availability of the service 100% of the time, or even that you'll be informed should the system decide to instigate a rapid weight loss plan for your pets.

Those in the IoT industry may wonder why it isn't becoming the big thing that people predicted. Well, it's precisely because of scenarios like this one, where the upshot is that if you want something done, do it yourself.

Mark Pickavance

LAST WEEK'S CROSSWORD

Across: 7 Educated Guess, 8 Gawain, 9 Twenty, 10 Rekoobe, 12 Story, 14 Share, 16 Haptics, 19 Credit, 20 Amon-Ra, 22 Teaches Typing.
Down: 1 Idea, 2 Octavo, 3 Standby, 4 CDATA, 5 Lucent, 6 Esoteric, 11 Ethernet, 13 Canasta, 15 Redact, 17 Troupe, 18 Et Seq, 21 Rank.

DISCLAIMER

The views expressed by contributors are not necessarily those of the publishers. Every care is taken to ensure that the contents of the magazine are accurate but the publishers cannot accept responsibility for errors. While reasonable care is taken when accepting advertisements, the publishers cannot accept any responsibility for any resulting unsatisfactory transactions. You know it's the Olympics when you find yourself sitting on the couch watching women's weightlifting at 1am on a Tuesday morning before having to drag yourself back in to work eight hours hence. As we write this, we're watching the cycling time trials in a tiny window of our monitor, wondering how

much more work we'd be getting done if the internet (and the BBC's amazing live feeds of the events) didn't exist. It's a conundrum, because the nature of our work has changed so much in the last decade that it's almost as unrecognisable now as the way we used to consume our entertainment, be it sporting or otherwise. Basically, while the internet has made our job quite a lot easier, it simultaneously offers a million-and-one distractions for someone who sits in front of a screen all day. Which makes it obvious that, to paraphrase a line fed to us by a colleague: "making a magazine is 1% inspiration, 9% perspiration, and 90% not getting distracted by the internet"... Well, ain't that the tru... oooh, look, cat videos. LOLZ.

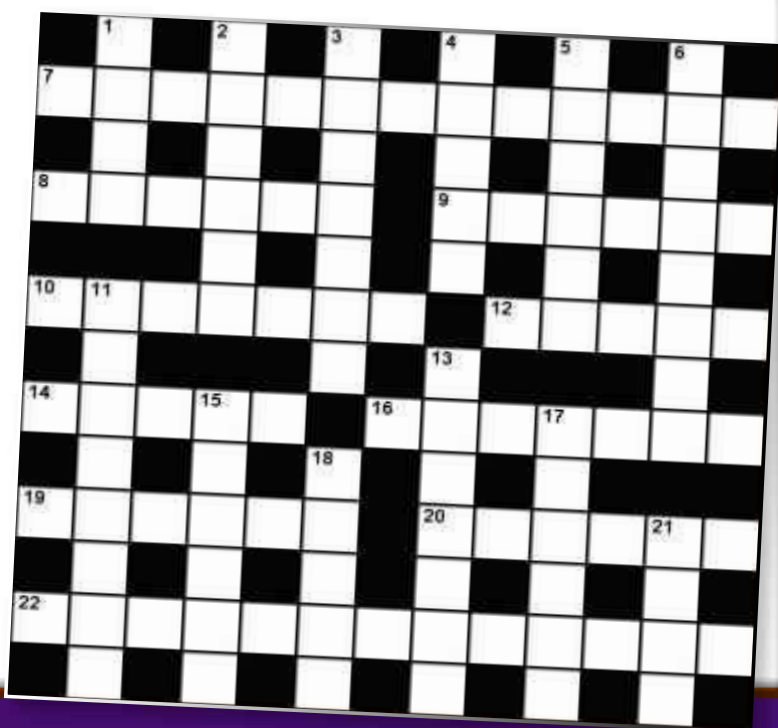
THIS WEEK'S CROSSWORD

Across

- 7 Home of the UK National Museum Of Computing. (9,4)
8 .ug TLD (6)
9 A photographic effect that can be applied to enhance images on social media. (6)
10 Avoiding detection by electronic techniques or by acting cautiously. (7)
12 Tear the thread or teeth from a screw or gear. (5)
14 An acquired or natural skill at doing something well. (5)
16 The smallest segmental unit of sound employed to form meaningful contrasts between utterances. (7)
19 Egyptian god originally connected with fertility, husband of Isis and father of Horus. (6)
20 A phoneme in a language that uses different tones for different meanings (6)
22 Someone who is expert in climatology. (13)

Down

- 1 A variable used to indicate a particular property of the data in a record. (4)
2 In XML it exists at the direct child level of the root <stream/> element. (6)
3 Collective term for branches of creative activity, such as painting, music, literature, and dance. (3,4)
4 Exalt to the position of a God. (5)
5 A very small computer application, especially a utility program performing one or a few simple functions. (6)
6 A business model, especially on the Internet, whereby basic services are provided free of charge while more advanced features must be paid for. (8)
11 He led the team that completed the rebuild of the iconic Colossus computer in 2008. (4,4)
13 A 1992 space flight simulator game developed by Vektor Grafik and published by Virgin Games. (7)
15 A measure of colour purity in the Munsell colour system. (6)
17 The period of a person's immaturity or youth. (6)
18 An interface that provides fast data transfer for external storage devices compared to FireWire and USB (Acronym). (5)
21 The property of a body that causes it to have weight in a gravitational field. (4)



In Next Week's Micro Mart*

- The best online office suites that aren't made by Microsoft or Google
- How the latest changes to the iPlayer could land you in trouble
- The greatest loading screens for the ZX Spectrum
- Plus the usual mix of news, features, reviews and advice



* May be subject to change

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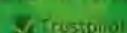
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